TROPICAL AGRICULTURE

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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

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TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture St Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

EMPIRE AVIATION.

THE growth of civil aviation since the war has clearly shown how useful the aeroplane can be in speeding up communications between the various parts of the Empire, and although much remains yet to be done, the British Air Ministry and the Royal Air Force may well be proud of what they have already achieved. Recent important trial flights have done a great deal towards influencing the public in realising the advantages and possibilities of air transport. Great strides have also been made in the development of new air routes. Although progress in that direction has so far been mainly confined to Europe, an air line has been firmly established from 'Iraq to Egypt, and it is anticipated that before very long there will be a regular service between England, India and Australia. Egypt itself may well become a centre for a net-work of Imperial flying services which would serve British territories throughout Africa, the Middle East and Asia. With regard to our tropical dependencies enough is already known to show that the aeroplane has a great future in East Africa while a survey of the more remote parts of West Africa may well reveal the possibility and utility of establishing air services there which would greatly speed up the opening up of new areas of settlement and commerce. With regard to the Dominions, Australia is already almost completely ringed by a chain of existing or projected air services, and in Canada new lines are being steadily opened up.

The opportunities for civil air transport in the West Indies have recently been examined by a Committee appointed by the Air Ministry. Their recommendations include the establishment of two overland routes in British Guiana and of three oversea routes from Trinidad, one to a range of Venezuelan ports and the island of Curaçao and the others to Barbados and Georgetown. To some, it would appear that these services would be inadequate in view of the fact that a number of the present inter-islands steamer connections are slow and irregular and consequently unsuited to modern business conditions, and it has been suggested that much greater advantages might accrue from creating an air service with its centre at Kingston. This is not the time or place to discuss such a suggestion: the point is that the Committee's recommendations are sufficient to show that steps should be taken

as soon as possible to start a British air service in the Caribbees, which, if it proved successful could be extended in the light of experience already gained. Furthermore, in lieu of encouragement, the West Indies are said to offer exceptional facilities for such a service as although there are risks of occasional hurricanes there are plenty of sheltered harbours and conditions for flying are generally ideal.

Quite apart from the transport facilities which aviation provides, it may, in future, be of very great value in survey work. Air surveying by means of air photography is a comparatively new science but it promises to be extremely important in the development of new countries, The fact that only about 20 per cent. of the Empire has been actually surveyed by modern methods on comparatively large scales, proves that much remains to be done still in this direction, and fortunately for the ground surveyor whose methods are necessarily slow and laborious, air photography has come to his aid. The value of this survey method was dealt with recently by Colonel H. L. Crosthwait in a lecture to the Dominion section of the Royal Society of Arts. The need of maps was emphasized as an essential preliminary to economic development as without them it is impossible to begin to gauge the economic resources in forests, minerals and agriculture of a new country, or properly to allot areas to those who are anxious to occupy them or to tackle engineering problems. Much money has been wasted and mistakes made by surveys and maps following development instead of preceding it. Air photography will, on the other hand, afford a rapid means by which preliminary reconnaissance survey work can be done over countries covered with natural obstacles such as mountains or forests trees. It should prove of great service for locating railways in unmapped countries and thus assist the engineer to decide upon the best and most economical lines to construct. It could also be used in the investigation of water power development and water storage for irrigation purposes, and has been used with success for coastal surveys and for discovering possible new trade routes. With regard to air photographs in relation to the economic development of new countries, Mr. R. Bourne, of the Imperial Forestry Institute at Oxford has stated from his experiences in Rhodesia that they could supply much useful information with regard to geological formations and mineral resources. In this respect it is claimed, amongst other things, that they could indicate the zones where soil conditions are exceptionally favourable to European or native agriculture and where forests ought to be reserved for commercial or protective reasons. Sufficient has been said to show what an important weapon air survey can be in the hands of those who are immediately connected with colonial development and it remains for the future to show the extent of the advantages that it is likely to afford.

In the sphere of agriculture the aeroplane has already been used with success in fighting fungoid diseases and insect pests. In Java it has been employed to combat rubber tree mildew and tea diseases, by dusting with sulphur which has been obtained from local volcanoes; in Canada to spray trees for pine blight and in carrying out research into the prevalence of wheat rust. In parts of America it has helped to control the cotton boll-weevil. In Trinidad the possibility of spraying sugar-cane fields seriously affected by the froghopper blight might be critically examined and indeed represents one of the recommendations made by the West Indian Air Transport Committee.

The aeroplane has been found of great service in still other directions. For instance, the United States Department of Agriculture has used them in the explorations it continually carries on for new varieties of plants that may be of value if brought under cultivation. It was possible in this way for Dr. W. Brandes to return from New Guinea with a large number of varieties of canes of which one specie was described as new to science. Collected by this rapid method of transport the canes can be brought alive and put immediately under cultivation and used for experimental purposes. Insect parasites could also be transferred from one country to another by this method. In Canada aeroplanes have been in use for sowing rice in the Manitoba marshes, for fishery protection, and for forestry work where they have been invaluable as observers in detecting fires and diseased areas. This use might equally well be applied to large tracts of cultivated lands in other parts of the world.

As will be seen, there is a wide scope for aviation in many branches of forestry and agriculture, and in the development of the resources of new countries. Aeroplanes have already shown that they can fulfil very useful purposes at comparatively low costs and it is to be hoped that they will shortly be employed in increasing numbers in all parts of the Empire.

COLONIAL APPOINTMENTS.

The following appointments and transfers have been made by the Secretary of State for the Colonies during the months of April and May, 1929.

April

Lieut. J. Eaden, B.A., Assistant Manager, Experimental Fruit Farm, Sierra Leone.

Mr. B. G. Stewart, M.R.C.V.S., Veterinary Officer, Uganda.

Mr. J. Heard, M.R.C.V.S., Veterinary Officer, Nigeria.

May

Mr. H. E. Green, Inspector of Plants and Produce, Agricultural Department, Gold Coast.

Mr. N. Burke, M.R.C.V.S., Veterinary Officer, Nigeria.

Mr. G. N. A. Hall (Veterinary Pathologist, Uganda), Veterinary Pathologist, Nigeria.

Mr. J. R. Mackie (Superintendent of Agriculture, Nigeria), Deputy Assistant Director of Agriculture, Nigeria.

PALM OIL EXTRACTION.

By F. J. MARTIN, M.A., Ph.D., F.I.C.,
Agricultural Chemist in charge of the Research Branch, Agricultural Department, Sierra Leone.

THE extraction of the edible oil from the pericarp of the fruit of the oil palm, *Elaeis guineensis*, is a domestic occupation all over West Africa in those places where the oil palm is found growing, although curiously enough it is, or until recently was, not practised in the interior of the Belgian Congo, where the oil palm grows in profusion. The methods of extracting the oil vary with the district, but they fall into two fairly well marked classes, those involving fermentation, and those not involving fermentation.

2. In order to indicate the problems involved in the extraction of oil, the palm fruit itself must first be described. This fruit consists of an inner kernel, varying from a quarter to half an inch in diameter, surrounded by a shell of varying thickness (from $\frac{1}{16}$ to $\frac{1}{4}$ of an inch) and this in turn is enveloped in a fleshy pericarp from which the well known palm oil of commerce is extracted. The value of the fruit depends chiefly on the thickness of the pericarp which may be thin or thick and form anything from 20 to 80 per cent. of the fruit. The percentage of oil in the pericarp varies somewhat but averages about 50 per cent. The proportion of oil to fruit obviously varies with the kind of oil palm ; it is about 20 to 25 per cent. in Nigeria, 10 to 15 per cent. in the common variety in Sierra Leone, while the carefully bred *Deli* oil palm in Sumatra contains about 30 per cent. of oil.

3. *Native methods of extraction.*—The method which involves no fermentation gives the better quality of palm oil and this will be described first, but there are hundreds of small variations from the actual process as here described.

4. *"Soft" oil process. Fig* 6.—The heads or bunches of palm fruit, weighing 30 to 50 lb., are harvested and allowed to lie for a few days for the fruits to loosen. The fruits are then removed with the aid of a cutlass, placed in an iron pot and boiled with water. The mass is stirred, prodded and beaten with wooden sticks to remove and break up the pulp surrounding the nuts, any oil rising to the surface of water being skimmed off. Sometimes the fruit is removed straightway to a wooden mortar and further pounded, and sometimes it is allowed to cool in the pot, but in either case the mass of pericarp and nuts is teased out and squeezed by hand in water to liberate the oil, which rises to the top of the water and is skimmed off and removed. After the pericarp has been well pulled about and as much oil as possible squeezed out, it is thrown away. The mixture of oil and water thus obtained is again heated to separate the oil, which is again removed by skimming, and the oil is subsequently "fried" to remove the last traces of water. A. C. Barnes (*Spec. Bull. Agric. Dept. Nigeria*, 1924) comments on the wastefulness of this process and showed that in an actual extraction by a native 35 per cent. only of the total oil was obtained, the remaining 65 per cent. being lost in the water, fibrous waste, &c. The oil obtained by this process is usually of a rich, reddish-yellow colour with a comparatively low free fatty acid content and a fairly low melting point. It is on account of this last quality that it is known as "soft" oil and the process by which it is obtained is called the "soft" oil process.

5. *"Hard" oil process or fermentation oil methods.*—These methods give an oil with a high free fatty acid content and a higher melting point than the "sort" oil process. The oil is described as "hard" oil and the method as the "hard" oil process.

6. There are many variations of this process, but the essential feature is the same in all cases : the pericarp is loosened from the nuts and broken down by fermentation, instead of by boiling or steaming. The method here described is such as is frequently met with in Sierra Leone but even within short distances there are differences in the exact procedure followed. The fruit, which may be allowed to ripen in the fruit heads for anything up to 14 days after harvesting, is removed from the heads and piled up in a heap in a canoe or in a stone lined hole in the ground, and covered with leaves. It is then allowed to ferment for some time, anything up to a week, at the end of which the fruit, which has been considerably softened by fermentation, is thoroughly mashed by the feet of natives trampling up and down in the canoe or pit. This trampling has the effect of removing the pericarp from the nuts and breaking down the cells containing the oil. Any oil which has been liberated runs down to the bottom of the canoe or pit and can be scooped up and removed. The mashed fruit is then treated with a comparatively large amount of water and the fruit further mashed and teased with the feet or hands. The oil squeezed out of the pericarp rises to the top of the water and is skimmed off. Sometimes the fruit undergoes two or three fermentations, the mash being extracted with water between each period of fermentation.

7. This process gives a poor quality oil containing a large proportion of free fatty acids, but when well performed it removes over 50 per cent. of the oil as compared with about 35 per cent. of the "soft" oil process. It is also less laborious, and although a poor quality oil is obtained, yet in view of the greater proportion extracted, it is the more remunerative method.

8. A somewhat curious method of extracting oil is used by the natives in Warra Warra, Sierra Leone. According to Capt. W. B. Stanley, C.M.G., who kindly supplied the particulars, the fruit is buried in a hole in the ground which is lined with leaves, and left there for a varying period up to six months. The fruit is then removed from the hole and pounded until the pericarp is separated from the nut. The pericarp is then placed in

another hole and hot stones heaped on top of it. The oil runs down to the bottom of the hole (which is lined with flat stones) and is subsequently scooped out. The oil solidifies on cooling, has a pungent odour and a flavour which is only appreciated by those with a cultivated palate.

9. All the above native methods are inefficient, messy and productive of inferior oil.

10. During recent years many attempts have been made to evolve a more efficient method of extraction suitable for use by natives. Two different lines of investigation have been followed: one is the modification of native methods to increase the proportion of oil extracted and improve the quality, and the other the substitution of small hand power plants designed for dealing with small quantities of fruit. In both methods the first objective is to stop fermentation of the fruit, as it is during fermentation that free fatty acids are developed in the oil.

11. Free fatty acids are produced by the action of lipolytic enzymes on the glycerides and these are decomposed into fatty acids and glycerol. The sooner the enzymes are destroyed the less the development of free fatty acids, and the object therefore is to treat the ripe fruit with heat as soon as possible in order to destroy the enzymes. It is for this reason that the oil produced by the "soft" oil process is better than that of the "hard" oil process, since in the former the fruit is boiled before mashing, while in the latter it is fermented first, and consequently a high proportion of free fatty acids is developed.

12. *Modified native processes.*—Work on these lines was carried out by Mr. A. C. Barnes, late of Nigeria. The object of this research was to discover some means by which, without the use of elaborate machinery, the native could improve on his method of extraction. The modification first designed by Mr. Barnes combined to some extent the "hard" and the "soft" oil processes. The method is as follows: the fruit is removed as soon as possible from the heads and is at once steamed, this prevents action by enzymes which decompose the fats. The steamers can be constructed from materials obtainable locally such as the iron drums used for the importation of petrol and lubricating oils. The fruit after steaming, and while still hot, is placed in an oblong pit or canoe, covered, and left over night. In the morning the fruit is thoroughly mashed by treading. It is then piled at the top end of the pit or canoe over a cylindrical piece of wood which is afterwards withdrawn leaving a channel underneath. The piled mass is then weighted with stones placed on short planks. Four or five hundredweights may be used without breaking down the pile or affecting the channel, and the super-imposed weights greatly assist in the extraction of the oil.

13. The expressed oil is collected and hot water (2 or 3 pints per 100 lb. fruit) poured over the mass. The fruit is again mashed by treading, weighted, and covered as before. The following morning the second batch of oil is removed and the fruit subjected to a water extraction. This consists of treating the fruit with a large quantity of cold water, say 20 gallons per cwt., and the pulp is then thoroughly teased and squeezed by hand as in the soft oil process. The oil rises to the surface and is skimmed off. It is then boiled and strained but not "fried" as in the soft oil process. By this modification Barnes succeeded in obtaining as high a yield with the modified method as from the hard oil process and of a quality nearly as good as that obtained by the "soft" oil process.

14. Subsequently Barnes evolved a "Cooker Press" method, which however necessitates the use of two simple pieces of machinery, namely, a "steamer" for softening the pulp, and a "press" for expressing the oil. The cooker can be made fairly cheaply of local material but the press has to be imported, and is relatively costly (about £22). Laboratory experiments with smaller and less costly presses were made and are now being continued both with the lever and screw types. The machinery is not nearly so complicated or expensive as plants including depericarping machines but the results obtained are apparently as good. Briefly, the method consists of steaming the fruits in a "Cooker," stripping the pericarp from the nuts by mashing them with a wooden pestle and mortar (ordinary native make), and expressing the oil from the mash in a small, hand-power, screw press. By this means from 60 to 70 per cent. of oil is extracted and the oil has a low free fatty acid content (2.5 to 10 per cent.) or is, in effect, of a better quality than that normally obtained by any of the native "soft" oil processes.

15. The cooking and mashing of the fruit are processes already familiar to the native and the only really new idea is the use of the press to squeeze out the oil. Whether this method will ever be adopted by the native depends on the cost of the press and cooker, and the efforts made to popularise the process.

16. *Small hand-power machines.* Several small hand-power plants have been designed but none can be described as successful and none have yet been adopted by the native. The most successful machine the writer has yet tried personally is that which allows for the steaming of the fruit followed by depericarping and then the expression of the oil from the pulp in a small hand press. The machinery involved was comparatively expensive and the extra amount of oil obtained was not sufficient to induce the natives, at any rate in Sierra Leone, to buy this form of plant.

17. From French Guinea it is reported that a form of cider press has been used experimentally with some success, but whatever its advantages the use of it does not appear to be spreading very rapidly.

18. More recently, several forms of small oil extracting plants have been produced but these, at the time of writing, are not yet actually on the market. They are much cheaper than the

PALM OIL EXTRACTION.

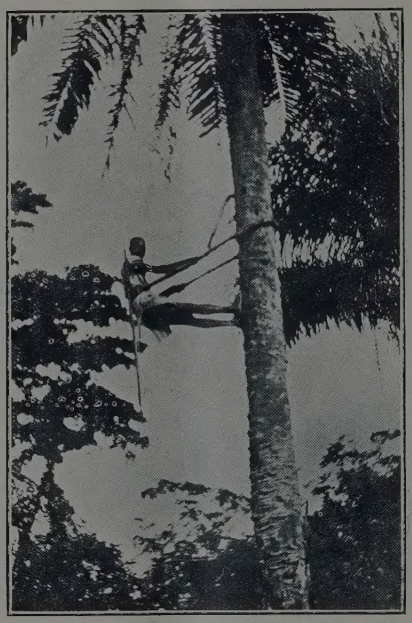
(Figures 3, 4 and 5 were kindly lent by Mr. M. T. Dawe and figure 6 by Mr. R. R. Glanville.)

1. *Oil Palm Plantation, Sierra Leone.*

2. *Young oil palm in 7-year old plantation.*

3. *Heads of oil palm and climber's girdle and knife.*

PALM OIL EXTRACTION.



4. *A palm oil picker, Sierra Leone (note cutting implement on back).*

5. *Transporting palm kernels.*

6. *"Soft" oil process. Mashing boiled fruit in native pestle and mortar.*

former plants and very encouraging reports have been received from the *Institut Colonial de Marseille* where these machines have been tested. The most interesting machine is a small, continuous hand press which treats previously cooked whole fruits and is stated to extract 60 per cent. of the oil and is not tiring to work. It cracks about 10 per cent. of the nuts, but is said not to damage the kernels. It can be mounted on a tree stump and worked by unskilled labour.

19. *Extraction of oil by Power Plants.*—An account of the manufacture of palm oil by modern factory methods was recently given by Jr. H. N. Blommendaal of the A.V.R.O.S. Medan, Sumatra (Serie No. 33), and an abstract of this paper, which is written in Dutch, is given in the *Malayan Agricultural Journal,* June, 1928.

20. The present day methods for dealing with fruit from large plantations involve a huge outlay on extraction plant to ensure that the whole of the oil is removed and that it should be of good quality. This latter point necessitates the sterilising of the fruit as soon as it is received. The method of sterilising is that of subjecting the whole bunches (as opposed to fruit only) to steam under pressure, in what are in effect huge autoclaves, capable of holding whole trucks of fruits; as many as six trucks, each holding a ton of fruit, can be treated in these large sterilisers. The steaming under pressure sterilises the fruit, assists in the coagulation of mucilaginous and protein matter—which tend to form emulsions with the oil during expression—and where the steaming under pressure is followed by vacuum treatment, much of the water in the fruit is evaporated. The kernels are also loosened in the shells, which facilitates the subsequent cracking of the nuts.

21. From the sterilisers the bunches go to the threshing machine, a sort of mechanical shaker in which the bunches are subjected to beating from revolving arms. The fruit falls between the arms and the débris is removed from the fruit, either by screening, or by being subjected to a blast of air.

22. The fruit is then digested in huge steam-jacketed mashing kettles which are fitted with a revolving shaft to which arms are attached. These arms working through the fruit gradually loosen the pulp from the nuts. The whole mass is transferred to a press, the most successful type of which is a "Swingbox" press. This press has two cages, one of which can be emptied and refilled while the other is being pressed. Each cage holds about 130 lb. of fruit and ten changes, or 1,300 lb. of fruit, can be treated every hour.

23. The yield of oil obtained from this expression varies according to the conditions. It depends on the moisture content of the material, the temperature during extraction (about 70° to 80° C should be maintained), the size of the perforations in the cage holding the fruit, the utilisation of press plates and the amount of pressure applied. It is unnecessary that this pressure should exceed 1,000 lb. to the square inch as palm oil is easily expressed.

24. The oil goes through clarification tanks and filter presses to storage tanks, while the pericarp which still contains a certain amount of oil, undergoes further treatment. The pulp is first removed in depericarping machines and undergoes a second expression at a greater pressure and may finally have the last traces of oil removed by a solvent extraction process, the solvent employed usually being the locally prepared naptha (B.P. 85-100° C).

25. The nuts, after removal from the pulp, go to driers, which are horizontal drums maintained at a temperature of 150° C by hot air. The drying of the fibre, combined with the friction of the passage of the nuts through the driers, removes the last traces of fibre from the nuts before they go to the cracking machines.

26. The centrifugal type of nut cracker is the most popular and it is usual to grade the nuts before cracking, each size of nut going to a separate cracker run at a speed suitable for that size of nut. In this way both the number of uncracked nuts and of cracked kernels is reduced.

27. The kernels are separated from the shell in a mud bath of which the specific gravity is about 1.17. In this the kernels float and the shell sinks. Brine solutions have been used but are too expensive. Recently, a firm have constructed a water separator based on the principle of an ore separator and this is said to give good results.

28. In the process described above, the hydraulic press is used for removing the oil from the pericarp but there are two other processes, the "centrifugal" process and the "solvent" process. The pressure method is the most popular in Sumatra but in Malay and in the Belgian Congo the centrifugal method is much used. In the Congo the factories are generally of a smaller size than in the East and this may be due to the fact that whereas in Sumatra the fruit comes from a comparatively small area of plantation, in the Belgian Congo it is derived from comparatively large areas of scattered wild palm stands, where it is considered that the extra cost of transporting the fruit to large central factories more than outweighs the advantages of larger factories. These small units are capable of dealing with about 3,000 tons of fruit a year and are not costly to erect.

29. It will be seen that up to the present time there is no method which is really successful, intermediate between the laborious and inefficient methods of native extraction, and the organised factory processes involving large capital, considerable staff and a continuous supply of fruit. It is probable that small scale pressure extraction plants will be difficult to construct for dealing adequately with the produce of West African palmeries, especially in those districts where the fruit is not of a very good type (*i.e.:* fruit with a thin pericarp), since efficient extraction by direct pressure is difficult where the pericarp does not form more than 33 per cent. of the fruit, and in some West African varieties the pericarp does

not exceed this figure. If, however, some form of continuous hand press, simple in operation, were constructed which could deal with cooked fruit in small quantities, and extract even 60 per cent. of the total oil content, it would be an enormous boon to the West African native, provided that the initial cost of the press did not prohibit its general use.

1928 ENGLISH BEET CROP.

Preliminary figures for the 1928-29 beet sugar manufacturing campaign have been received. The area under sugar beet, as shown by the Agricultural Returns for 4th June, 1928, was 175,736 acres, a reduction of 21 per cent. on the 1927 acreage. This fall in acreage may be attributed in the main to two causes :—

(1) The reduction in the growers' price consequential on the reduced rate of subsidy.

(2) The poor average crops obtained in 1927 as a result of adverse climatic conditions.

Only one new factory—at Brigg, in Lincolnshire—was erected in 1928, the total number of factories in operation being 18.

An improved yield per acre, 7.8 tons as against 6.5 tons in 1927, largely counteracted the lower acreage and resulted in the total quantity of beets delivered to factories being about 1,374,800 tons as against 1,449,152 in the previous year. The average sugar content was 17.32 per cent. as against 16.12 per cent. in 1927. The higher sugar content improved the factories' outturn of commercial sugar, which is estimated to have been 3,900,000 cwt. as against 3,651,620 cwt. in the 1927-28 campaign. This means an average of about 2,500 lb. per acre of beet under cultivation as compared with 1,838 lb. in 1927.

On the whole, climatic conditions in 1928 were favourable to the crop, except for a spell of cold and dry weather at the end of April and beginning of May, which retarded germination and early growth. Harvesting was carried out under satisfactory conditions and resulted in the beet deliveries being much cleaner than in the previous season, the average tare being 14.5 lb. per cwt. as against 20 lb. during the previous campaign. The average price paid for beets under the contract was about 51*s.* 9*d.* a ton compared with 55*s.* 6*d.* in 1927, the decrease being due to the reduced basic price consequent on the fall in the rate of subsidy. About 97,000 tons of dried pulp and 11,000 tons of wet pulp were produced during the 1928-29 campaign, compared with 88,000 tons and 15,000 tons respectively in the previous one. It is satisfactory to note that over 90 per cent. of the dried pulp was sold for home use as against 75 per cent. in 1927-28. The production of molasses is estimated at 1,010,000 cwt.—(*The Journal of the Ministry of Agriculture*, Vol. XXXVI, No. 1, April, 1929.)

WHITE SUGAR MANUFACTURE.

By R. H. Hurst, B.Sc., Ph.D., A.I.C. and W. Scott, B.Sc.

Experiments were carried out in the College Factory on the manufacture of white sugar (*a*) from remelted raw sugar, (*b*) direct from cane-juice, "Suchar" carbon being used for each process.

1. Refining of Raw Sugar.

For this process raw sugar of 96° polarisation was washed with water in the centrifugals to a purity of 99°. The sugar was then dissolved in warm water in a mixing tank to a syrup of 66° Brix, the syrup so produced being of a purity comparable with that of refinery syrup after 'affination.' "Suchar" carbon in the proportion of 1 per cent. on solids was added and the mixture kept agitated at 85° to 95°C. for about 20 minutes. It was then pumped through the filter press.

(The possibility of using this filtered syrup, either directly or with partial inversion to allow of concentration to over 70° Brix, for sweetening or preserving purposes, is receiving our attention.)

The filtered syrup was evaporated in the vacuum pan and crystallised in the ordinary way. A hard, brilliant white sugar was produced, the polarisation of which was 99.8°. This figure was rendered too low by the fact that, in the absence of a drying arrangement, the sugar retained a slight amount of moisture.

The surface-tension of the syrup before treatment with "Suchar" was 66.1 dynes, that of the filtered syrup 72.7 dynes, or approximately the value for a chemically pure sucrose syrup as shown by the drop-weight method.

The "ash" of the washed raw sugar of 99° polarisation was 0.1203 per cent. and that of the final white sugar 0.0335 per cent.

The filtered syrup gave no precipitate with acidified alcohol, indicating the complete, or sensibly complete, removal of colloidal material. After standing for a day or two, sugar crystals began to appear and grow in this solution, but at no period was there the least sign of turbidity.

Perhaps the clearest indication of the purity of the filtered syrup was supplied by the fact that the "molasses" from the final sugar was practically colourless.

2. Plantation White Sugar.

In this process cane juice was sulphited and limed to a slightly acid reaction. The clarified juice was evaporated to a syrup of a little over 50° Brix. The syrup was run into a mixing tank where vegetable carbon, in the proportion of 4 per cent. on solids, was added. The mixture was kept agitated at 85° to 95°C. for 20 minutes and then pumped to the filter press. The filtered syrup was very slightly coloured, but the colour

deepened on concentration in the vacuum pan. It was necessary to wash the resulting sugar thoroughly in the centrifugals. The sugar obtained had a polarisation of 99.2°. When viewed side by side with refined granulated sugar the very slight greyish colour appeared more pronounced. It is, of course, impossible to produce, at least on a factory scale, a white sugar direct from cane-juice equal in appearance to refined sugar, since quite apart from the clarifying action of carbon, the latter sugar is subjected to the process of recrystallisation. Without the latter process, it appears impossible to free the sugar crystals entirely from their thin films of impurities, which on storage give rise slowly to dark-coloured oxidation products.

The "ash" of this sugar was 0.059 per cent.

Analyses of composite samples of the syrup before and after treatment with "Suchar" were carried out by methods already described (Hurst and Scott, 'Cane Syrup,' Sugar Technology Memoir, No. 1, July, 1929). To make the results more comparable so far as the action of the carbon is concerned, the untreated syrup was heated and filtered rapidly, with suction, through a No. 4 Whatman filter paper, in the laboratory.

The analytical results are expressed as a percentage of the Brix in each case :

	Untreated.	*Treated.*	*Per cent. removed.*
'TOTAL' NITROGEN ..	0.1134	0.1008	
CRYSTALLOIDAL NITROGEN ..	0.0882	0.0828	
NON-CRYSTALLOIDAL NITROGEN (=Difference above two)	0.0252	0.0180	29
'ALCOGEL' (Acetic acid-alcohol ppte.)	1.82	1.70	7
PENTOSANS ..	0.0410	0.0303	26
PECTINS (as Ca pectate) ..	0.0086	*Nil.*	100
ASH	1.79	1.63	9

For the following physical measurements samples of each syrup were diluted to exactly 50° Brix :

	Untreated.	*Treated.*
SURFACE TENSION (Dynes)	51.3	70.3
VISCOSITY (Secs) ..	133.5	131.0
SPECIFIC ELECTRICAL CONDUCTIVITY (mhos $\times 10-3$)	2.84	2.84

Discussion of Results.

The results showing the action of carbon confirm in general our previous experience (Hurst and Scott, *loc. cit.*).

With regard to pentosan removal, some confusion was caused in the discussion of our previous paper owing to the fact that removal of pectins shows, by the analytical methods employed, an apparent removal of pentosans. In the present case the pectin content of the untreated syrup was so small as to have little or no effect on the pentosan determination. It is clear that an appreciable amount of pentosan is removed by adsorption on the carbon. Pentosans almost certainly consist of highly hydrated colloid particles of great stability and their larger concentration in molasses is doubtless an important factor in promoting the high viscosity of this product. The almost negligible pectin content shown for the untreated syrup is probably not due entirely to efficient clarification of the original cane-juice, but also in part to the laboratory filtration of the sample before analysis. It is probable that the presence of finely divided suspended material will yield some sodium pectate in the first stage of analysis. In this connection it is important to express our opinion that both pectins and pentosans can find their way into juices in a "soluble" form by the splitting up of suspended "insoluble" material during manufacturing processes, particularly when the reaction of the medium is on the acid side.

The removal of 29 per cent. of non-crystalloidal nitrogen is smaller than was expected and it seems unlikely that the non-crystalloidal nitrogen as determined by this method consists entirely of protein nitrogen. There appears to be scope for further research work on the nitrogenous constituents of cane-juice and their behaviour during manufacture.

The removal of 9 per cent. of 'ash' points to efficiency of the carbon ('Suchar') filtration. The electrical conductivity of the clarified syrup showed no change from that of the untreated syrup, indicating that no soluble 'ash' was removed. The decrease in total 'ash' (determined by incineration) must therefore represent insoluble material which was in a sufficiently fine state of subdivision to pass through the open-textured No. 4 Whatman filter-paper. This result, incidentally, shows the discrepancy which might arise between conductivity and 'ash' relations, when dealing with products containing insoluble 'ash.'

The physical measurements again show that surface-tension is the most significant measurement in indicating the remarkable clarification of the syrup on treatment with carbon, and there is little doubt that greater use will be made of this measurement in the future.

SUMMARY.

1. An outline is presented of the process of manufacture of white sugar from remelted washed raw sugar by the use of vegetable carbon.

2. A process of manufacture of 'plantation white sugar' by treating cane-juice with sulphur dioxide and lime and the resulting syrup with vegetable carbon is outlined.

3. Results of analyses of composite samples of the latter syrup before and after treatment with carbon are tabulated and discussed.

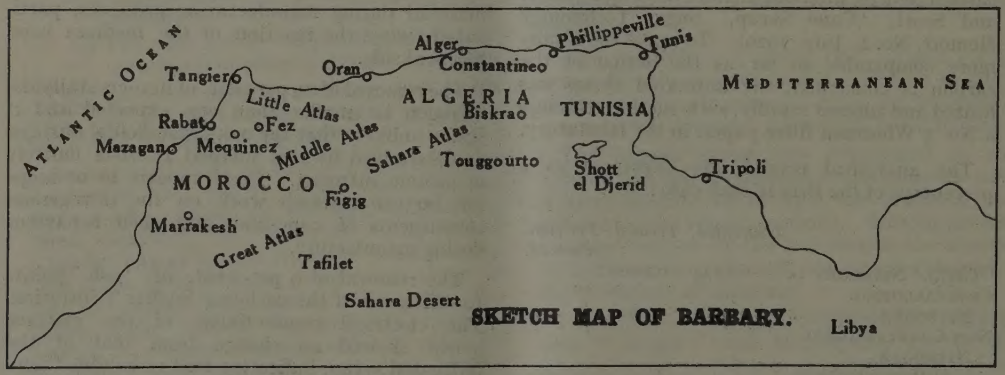
AGRICULTURE IN NORTH AFRICA.

By V. H. W. DOWSON, M.A., Dip. Agric. (Cantab.).

Introduction.

THE following article is an account of a tour in North Africa which was made through the kindness of His Majesty's Secretary of State for the Colonies and of the Government and of the Director of Agriculture of the 'Iraq. The object of the tour was to study the agriculture of the three states of Barbary, that is to say, the Regency of Tunisia, the three *départements* of Algeria and the Protectorate of Morocco. All three countries have much in common with the 'Iraq with regard to the land, the climate and the influence of Arab immigrations which has deeply affected farming as well as the peoples' lives. The French in North Africa have met agricultural problems very similar to those of the Government of the 'Iraq and to those caring for the welfare of the latter country, a country having no wealth but the potential wealth of its soil and subsoil, the solutions which the French have found are, in the least, interesting and, perhaps, may have much worth.

The writer uses this opportunity of acknowledging his debt to all those who made the journey possible and profitable, namely, officials of His Britannic Majesty's Consular Service and of the French Agricultural Services for their unfailing courtesy and ready help, and, especially, those very gallant gentlemen, the officers of the French Army met in Southern Algeria and Morocco, whose overwhelming kindness made delightful an arduous tour, and whose amazing hospitality will never be forgotten.



SKETCH MAP OF BARBARY.

Geographical.

Morocco (162,000 sq.m.), Algeria (222,000 sq.m., not counting desert), and Tunisia (48,000 sq.m.), together form a geographical unit by virtue of the many characters which they share in common and which distinguish them from adjacent territory. Among the many names, such as "Africa Minor" or "The Country of the Atlas," which have been proposed for this geographical unit, called *Al Maghrib*, by the Arabs, none appears so suitable as the ancient title of Barbary.

On the West, Barbary is bounded by the Atlantic Ocean; on the North and East by the Mediterranean Sea; and on the South by the Sahara desert. Tunis, near the most northerly point in this region, is in almost the same latitude as Mosul; Mazagan is in almost the same latitude as Baghdad; and Agadir is in almost the same latitude as Basrah.

Most of the country is high; and though the mountain system is complicated, it may be said to be divided into two main ranges, the more northerly comprising the Middle Atlas and the Tellian Atlas, and the southern, the High, Anti-, and the Saharan Atlas, with its extension the Djebel Aurès.

Between the central and eastern portions of the two ranges is a high, rolling plateau, which, in many respects, resembles the Mosul plains. The three ranges of Atlas in Morocco rise to over nine thousand feet, but only to about seven or eight thousand in Algeria and Tunisia. The highest point in the whole system is Ouenkrim, to the South of Marrakesh, which reaches 13,690 feet.

In appearance, climate, agriculture, and products, there are many points of resemblance between these mountains and those which bound the 'Iraq on the North and East. The southern edge of the southern ranges forms a definite and nearly continuous boundary running for thirteen hundred miles in a south-westerly and north-easterly direction, and divides Barbary from the desert and semi-desert country, most of which is known and administered under the name of *Les Térritoires du Sud de l'Algérie*. It is this flat, arid country, to the South of the Saharan Atlas, dotted with occasional groups

of date palm oases, which most resembles the lower part of the 'Iraq ; though it has no large rivers which carry water all the year round.

To the East, is the large and important oasis of Tafilelt, and a few minor ones, of which the biggest is that of Figig.

In the South, are, amongst others, the oases of the Mzab, the Zibane, the Oued Rir, and the Oued Souf. *Fig.* 9.

In southern Tunisia there is the famous Jerid, comprising the four oases of Tozeur, Nefta, El-Oudiane, and El-Hamma, the forty small oases of the Nefzaoua, together with other minor ones. These oases cluster round the salt lake, the Shott el Djerid, which fills the eastern end of the depression that stretches from the Oued Rir to the Gulf of Gabes.

Meteorological.

Barbary itself has a climate warmer in winter than that of the territories bordering the northern and western shores of the Mediterranean, being but little warmer than them in summer ; but, south of the mountains, the summer and winter temperatures are nearly the same as those which prevail in the 'Iraq. That is to say, Barbary proper has a Mediterranean climate and the Southern Territory has a very pronounced continental climate, in the older sense of the word, characterised by great diurnal and annual ranges of temperature, excessive summer heat, and low rainfall, all of which falls in winter.

In north-western Morocco, there is usually a daily breeze from the sea and a nightly breeze from the land, but the prevailing wind is from the south-west, over the Atlantic Ocean ; the northern part getting little wind in summer and the southern little in winter. The Southern Territory is characterised by the *siroco* or sirocco, a violent and usually unpleasant wind, corresponding to some extent with the *shamal* of the 'Iraq, at any rate, in so far as its adverse effect on vegetation is concerned. A particular feature of southern Tunisia, this wind blows irregularly from all directions during all seasons, its heat and dryness being most noticeable in spring and autumn. Not only does the *siroco* fatigue both man and beast, but it may prevent fertilization in cereals, the setting of fruit, or the maturation of olives, and has been known to prevent the proper fermenting of the local wines. On the other hand it has a discouraging effect on cryptogamic and insect parasites.

Much of the higher land in Morocco receives a rainfall of over thirty inches, but the rainfall in Barbary as a whole is only from fifteen to twenty inches. Algiers has thirty inches annually, but Tunis about half that amount. The rainfall in the Southern Territory is similar in amount to that which falls in the 'Iraq : in the North, that is, at the bottom of the southern slopes of the Saharan Atlas, eight to ten inches of rainfall, while, further South, in the same latitude as Baghdad (Touggourt), there is about two inches less rainfall.

Flora.

General.—The coast region of Barbary has a Mediterranean flora, as might be expected from its Mediterranean climate. Evergreens and sclerophyllous vegetation predominate, and the olive, *fig.* 12, up to three thousand feet, is the typical tree. The moister mountain sides, especially the northern slopes, and many of the higher plains, are covered with vast forest of Cork Oak, Holly Oak, Thuya, Cedar, Pine (*Pinus halepensis* ; Arabic, *Sanubar*), and Wild Pear. Occasionally, isolated clumps of Poplars are to be found in the damper parts. In places too, on the moister hill-sides, one notices groups of Cypress trees (*Cupressus sempervirens*).

Forest Trees.

The Cork Oak.—Cork Oak trees (*Quercus Suber ;* Arabic, *Farnana ;* Berber, *Tafran* or *Izgi*) of about twenty-five years of age, and of which the trunks are from a foot to a foot and a half in diameter, are ringed at a height of a foot and again at about six feet from the ground, and the bark split off. This bark is the "male oak," inelastic and of but slight value. In about eight years, the tree is again covered with bark ; which forms the "reproduction cork," the ordinary cork of commerce. As the Forestry Service in Morocco was organised only in 1914, little cork has yet been exported. By the end of 1918, however, the Service and a private company had performed the preliminary operation on over a million trees, and it is to be expected that the industry will become important in Morocco. The comparatively small Tunisian forests exported nearly six thousand *tonnes* of cork in 1920 ; but it must be remembered that in both Algeria and Tunisia a great deal of wine is made and much cork is consumed locally for corking the bottles. Algeria, where the forests are exploited by private companies as well as by the State, annually produces about thirty thousand *tonnes* of cork. The trees which are too old to give satisfactory cork are ringed deeply, and from the cambial layers tannin is extracted. When the trees die, they are used for the production of the best quality charcoal.

The Holly Oak. Fig. 8.—The Holly Oak (*Quercus Ilex ;* Arabic, *Qarush*), which is found growing high on the mountains, provides timber especially valuable for railway sleepers. Tannin is extracted from the bark. Though this tree grows in exposed and somewhat dry places, yet its range stops very abruptly along the ridge of the southernmost ranges of Barbary. The writer remembers toiling up from the Moroccan Sahara over a pass of the High Atlas. Bare, scorched rock and forbidding cliff faced him all the hot day, until, the summit reached, the northern,

downward slopes refreshed his eyes, slopes richly green with their covering of Holly Oak, and lower, of the Wild Olive. Standing on the pass, the contrast was striking: to the North-West, the whole countryside was green: to the South-East, on the southern slopes of the mountains, nothing met the eye but blistered surfaces, bare of vegetation.

The Thuya (*Tetraclinus articulata*) trees are mingled with the Holly Oaks in the higher forests. The tree is called by the Arabs '*Arar* and produces the valuable "arar wood" of commerce, durable, perfumed, hard, and capable of taking a high polish. The resin forms the gum sandarach, which is used in the best varnishes. In 1917, Morocco exported this product to the value of six hundred and seventy-five thousand francs. The dried, scale-like leaves are mixed with tobacco, and smoked in tiny pipes by the Kabyles and by the people of the South. The effect of this drug is said to be similar to that of opium, but the two small pipe-fulls which the writer smoked appeared not to affect him in any way. Camel men, and people of a similar class, however, are passionately fond of smoking it, and are miserable when prevented from doing so. As far as the present writer has been able to discover, this use for the leaves of *Tetraclinus* appears not to have been recorded previously.

The Cedar.—The Cedars of Lebanon (*Cedrus Libani*, var. *atlantica*; Arabic, *Maddad*) of the damper and richer parts of Morocco and Algeria form magnificent forests. There are few more impressive sights than the masses of these immense and stately, century-old trees, ranged rank upon rank upon the northern mountain slopes. Their wood has been famous from immemorial time for the manufacture of the exquisite woodwork of old Moroccan houses; and the constructors of modern French buildings have not been slow to realise its virtues.

A Lyauty road has been made right through the richest of these forests, and a railway is being built to Azrou, the centre, where an energetic French company is exploiting the region. The cedar forests of Azrou and Ain-Leuh, together with the much higher ones of Rabah El Behar and Bou Jerir, where the cedars are found at six thousand feet above sea level, yield about five hundred and ten thousand cubic feet of squared wood a year.

The Argania.—This tree (*Argania Sideroxylon*) although not an inhabitant of the mesophilous woodlands, nevertheless, is characteristic of a large part of Morocco, the coastal plain of the South. There is only one species in this genus of this useful order (*Sapotaceae*). and this is found nowhere but around Marrakesh, where it covers over a million acres. It can grow in very ungenerous soil and withstand animal attack. Its wood is hard and valuable; flocks feed on its leaves and drupes, and shelter beneath its shade; but its principal value lies in the oil which is expressed from the seeds. This oil has very nearly the same composition as olive oil. Animals eat of the fruit; but the hard nuts which remain undigested are collected, the kernels removed, and the oil extracted with hot water.

Other types of vegetation.

The temperate rain forests pass insensibly into the *brousse* or *maquis*, the bush vegetation of the drier regions, where the Holly Oak grows dwarf, or is replaced by the *Quercus Mirbeckii*, and where lavender, thyme, sage, and mint become common plants.

The *maquis* gives place in the still drier and still more mountainous regions to the *garigue*. There is but little humus in the soil, but the small bushes seem to get a footing in the clefts in the rocks. Winter scarcely stops their growth, though in summer there is a resting period, and excessive transpiration is guarded against by the multitude of ingenious devices which characterise sclerophyllous vegetation.

The Dwarf Palm.—Vast areas of the high tableland, or steppe country, however, are covered with nothing but the dwarf palm, *Chamaerops humilis*, which sends its fanlike leaves two feet above the surface of the soil, and grows no taller. From these leaves are made the "vegetable horse-hair" of commerce. In 1912, Algeria exported fifty-six thousand *tonnes* of this fibre; but the industry is not really important. The collection of the raw material, rather like that of the liquorice root in this country, is difficult, and carried out, usually, when the harvest has failed and the cultivators are in need of money.

Alfa Grass.—The steppe country of the high plateaux, especially the more southern, is covered with Alfa Grass (*Stipa tenacissime*, the *Halfah* of the Arabs). In western Morocco, alfa does not form the whole of the vegetation for vast areas as it does in eastern Morocco and in Algeria. In Tunisia, also, comparatively little land is entirely covered by it. This thin-leaved grass, also known and used in the 'Iraq, is collected under the direction of administrative and agricultural officials, who guard against a too zealous cutting, resulting in a diminution of its area, which at present is about ten million acres in Algeria. In 1921, thirty-seven thousand *tonnes* were exported for paper making, nine-tenths of which went to the United Kingdom. The maximum export for any one year was in 1912, before the control was exercised, and amounted to over a hundred thousand *tonnes*.

Xerophytic vegetation.—The truly desert country, and, consequently, the truly xerophytic vegetation, are not met with (except at the fringes of the salt lakes of the steppes) until the plain of the Sahara is reached, to the south of the mountain chains. Close to the mountains, in the *wadi* beds, the Oleander (*Nerium oleander*; Arabic, *Diflah*),

which plant the Arabs say indicates bad water, and the Tamarisk (*Tamarix articulata;* Arabic, *Athal*, the tree tamarisk; and *Tamarix gallica;* Arabic, *Tarfah*, the bush tamarisk) are common, as also are various Jujubes (*Zizyphus lotus*, *Z. Spina-Christi*, and *Z. vulgaris;* Arabic, *Sidrah* (tree), *Nabak* (fruit), and various acacias (*Acacia tortilis*, and *A. Nilotica*). Stretching, too, in a long belt fringing the northern edge of the desert is to be found the *Batum* tree (*Pistacia atlantica*), of friendly shade. Altogether, there must be an enormous number of these trees in the Southern Territory of Algeria and it is a pity that they are not closer together.

Halophytes.—Familiar halophytes, familiar, that is, to the 'Iraqi, are the members of the remarkable order, *Chenopodiaceae*, *Suaeda vermiculata* (Arabic, *Usairah*), *Salsola tetragona* (Arabic *Suwaid*), and *Atriplex halimus* (Arabic *Gitaf*), which are all common salt bushes of the Southern Territory. A member of the order, characteristic of parts of the northern Sahara, namely, *Anabasis aretiodes* (Arabic, *Daga'a*), the *Choufleur du Désert* of the French, is, however, not met with in the 'Iraq. This plant is almost the only living thing seen in great stretches of the stony desert; and it gives the latter the appearance of being littered with innumerable fat cauliflowers, of all sizes, but all deprived of their leaves.

'Iraqi would recognise the Colocynth (*Citrullus colocynthus;* Arabic, *Handhal* ('Iraq), *Hadaj* (Algeria)), also the small, thistle-like plant, *Zollikoferia spinosa* (Arabic, *Bukhalalah*), a very spinous herb with a remarkably bitter taste. Despite the latter, camels eat of it readily. However, even the gustatory catholicism of the camel is offended by *Cleome arabica*, the fetidity of which is such that one small bush can make the air unpleasant thirty feet away. Camels are very fond of the string-like leaves of a deep-rooted, hardy grass *Aristida pungens*, the *Drin* of the Arabs. Parts of the sandy desert are dotted with tufts of *drin*, from which the passing camel snatches a hasty mouthful. The writer's camel man told the story of a theft in his oasis. A traveller, the owner of a one-eyed camel, blind in the near eye, was suspected as the thief. This camel man followed each of the many tracks across the sand leading from the village, until he came to one such that, when it led between two tufts of *drin*, the right hand tuft consistently was eaten off and the left hand not. This, it was rightly proved, was the track of the blind-eyed camel. The owner was overtaken and the crime expiated.

Ephedra and Ratam. Fig. 10.—Two other plants, common camel food, and prominent features of parts of the great sand dunes are an *ephedra*, *Ephedra alata* (Arabic, *Alandah*) and a legume, *Ratama ratam* (Arabic, *Ratam*). These *ratam* bushes, plants with extraordinary powers of drought resistance, form veritable oases in themselves. Wheatears shelter beneath them during the greatest heat of the day: the large, black, dung beetles make their caverns close to their roots; and the snake and lizard keep their watch within the shade. Occasionally, from bush to bush, across the smooth sand, there may be seen the complicated tracks of a beetle's six legs, those of the lizard, showing foot and tail marks, or the perfectly regular sinusoidal trail of a snake. It was remarkable that such a highly specialised parasite as one of the *Orobanchaceae* (either *Orobanche or Phelipaea;* Arabic *Surtuth*) should be found living upon the *ratam* in the Sahara.

The date palm. Fig. 11.—The date palm does not grow wild, but is, nevertheless the most characteristic of all the plants met with south of the mountains.—(*To be continued.*)

SOYA BEANS.

Owing to the many new uses that are constantly being found for vegetable oils, and the ever-increasing popularity of oil cake and meal as a stock feed, oilseeds are year by year assuming a more important place in world trade. World production for the year 1926 approximated 35,900,000 short tons, of which about one-third was exported from the country where it was grown, either in the form of seed, or as oil and oil cake and meal. Cottonseed is by far the most important of all oilseeds, world production in 1926 having been nearly 14,000,000 short tons, or about 40 per cent. of the total production of all oilseeds.

Other oilseeds, in order of their relative importance, are sesame seed, flax seed and soya beans (peanuts not being considered, as a comparatively small proportion of them are crushed). Soya beans are of Asiatic origin, and have been raised for many centuries in China, which is still the chief source of supply, and where they play an important part in her foreign trade. Manchuria is the great producing area, supplying about 40 per cent. of China's total crop.

According to Mr. F. T. Pope, Foodstuffs Division, United States Department of Commerce, a short ton of soya beans (33½ bushels) produces about 240 lb. of oil when crushed and 1,620 lb. of cake or meal, the remaining 140 lb. being invisible waste, mostly moisture thrown off in the process of manufacturing. The oil of the soya bean is probably one of the most versatile of the great varieties of vegetable oils in world commerce to-day. Its most extensive use as an edible oil is in the manufacture of lard compounds and oleomargarine, and a small amount in salad oil.

In addition to its uses as an edible product, it has the properties of a drying oil, which lends itself to the paint and varnish industry, and the manufacture of soap, linoleum and oilcloth, while small amounts are used for illuminating and lubricating purposes in its native country. Owing to its high protein content, ranging from 46 to 52 per cent., and from 5 to 8 per cent. oil, soya bean meal is in great demand as cattle feed, and commands a considerably higher price than either cottonseed meal or linseed meal.—(*The Chamber of Commerce Journal*, Vol. LVII, No. 786.)

SUGAR-CANE BORERS.

By R. W. E. Tucker, M.A., B.Ed.

Diatraea saccharalis (Fabr.) *and Diaprepes abbreviatus* (Linn.).

Control Measures in Barbados.

A campaign has been started by the Department of Science and Agriculture in Barbados for the control of the above pests, based on the mass breeding and liberation of the Trichogrammid egg parasite of "Diatraea" and on the voluntary co-operation of planters for the collection of newly emerging adults of "Diaprepes" The following article is based on a lecture given by Mr. R. W. E. Tucker, M.A., B.Ed., describing the methods adopted for breeding the parasites and making known to the planters the procedure that they are to adopt in distributing them.

Introduction.

It is not proposed to go into details of the various aspects of biological control, that is the utilisation of one kind of organism (usually an insect) for the control or destruction of another.

Broadly speaking, the usual or better known application of biological control can be divided into two aspects, namely the introduction of parasites from other countries, and the artificial rearing and liberation of indigenous parasites earlier than they would normally appear, and in numbers that Nature unaided could never produce.

When parasites are introduced from elsewhere, it is essential to ensure that they are free from hyperparasites before being liberated. It may also be necessary to take steps to increase their number artificially and to establish them, for some time after introduction. Both these conditions were fulfilled in the case of the parasites *Ipobracon grenadensis* (Ash) and *Microdus* sp. which were introduced into Barbados in 1926-7; yet neither of these parasites can now be discovered in the Island, and have apparently failed to establish themselves.

When an indigenous parasite is used, such as *Trichogramma minutum*, Riley, both conditions are already fulfilled, for one would not use a parasite which was in turn hyperparasitised by other insects.

There remains then the mass rearing and liberation of the parasite at a time and for a period which will ensure that there are always parasites on hand to attack the pest insect as it attempts to breed up. The method of doing this will be described later.

First of all, it must be made clear that normally a state of equilibrium exists between the pest and the chosen parasite. The Trichogrammid in question parasitises and destroys the eggs laid by the moth borer on the cane leaves, and by the end of the season (as at present ascertained in Barbados) it exerts at least a 90 per cent. control over the pest. During a period every year therefore, both pest and parasite revert to a minimum in numbers.

The parasite, it would appear, maintains itself in small numbers outside the cane fields, mainly in the eggs of *Utethesia ornatrix* and probably to a small extent among old canes. The pest, however, is at this period provided with young canes planted invariably in close proximity to fields of old borer infested standing cane. The moth therefore obtains a fresh start in its host plant and is in addition, a prolific breeder. Moreover, of necessity, much damage must be done to the growing canes by moth larvae before the e are sufficient moths at large again to provide egg masses wherein the parasite can find scope for its own rapid reproduction. Therefore by the time the parasite has increased sufficiently to exert an appreciable check on the pest, the maturing canes have already suffered heavy damage. This damage is caused by bored canes breaking off at badly bored joints, or rotting owing to the ingress of fungi by means of borer lesions, or to the borers killing the growing points of young shoots and so destroying potential canes. Added to this, such canes as are not killed outright suffer a certain loss in weight, vitality, and in purity of juice. An estimate of this loss is given later.

The objective therefore of the type of biological control to be described, is to maintain a continuous concentration of parasites in the field, so as to parasitise borer eggs as they are laid, and eventually to build up a supremacy of the parasite over the pest sufficiently early in the season to prevent the damage detailed above.

Method of Mass breeding Trichogramma.

The technique used is based on American methods originated by Mr. S. Flanders at Saticoy, California, and applied last year by the Louisiana Experimental Station to the control of *Diatraea* in that region. There is no need therefore to add to the accounts already published on this work.

The usual ant proof breeding units for the rearing of the angoumis grain moth, *Sitrotroga cerealella* were erected and equipped, and provided with vacuum pipes connected to an engine in a neighbouring building. The grain moth eggs required to infest the corn in the moth units were obtained through the courtesy of the United States Bureau of Entomology, as no adequate source of supply existed in Barbados.

When sufficient moths are breeding out, they are collected in gauze capped cylinders placed in an apparatus which can be attached to the various nozzles in the vacuum pipes. Large numbers of moths are thus collected uninjured, and are allowed to deposit their eggs overnight through the gauze ends of their containing cylinders. The following day, these eggs are assembled, cleaned and dusted on to sheets moistened with gum arabic. When dry, the sheets of eggs are exposed to the Trichogrammid

in an ant proof insectary built for the purpose. It was not possible to use the latest equipment and devices as published by Flanders, but an average increase of six fold in the parasites used is maintained.

By means of a series of counts, the average number of eggs per sheet used is known, and likewise the number of parasites that a sheet will yield. Each sheet is divided by printed lines into 16 sections, permitting its rapid division into units suitable for distribution throughout cane fields, and each unit yielding a known average number of parasites.

These sections are cut and placed in containers holding 12,000 parasites each, in a cold storage box built for the purpose. When taken out for distribution as detailed later, it is known that the parasites will hatch within 24 hours of being handed to the planters.

In order possibly to strengthen the local *T. minutum* through cross breeding, colonies of *T. minutum* were obtained from Louisiana through the courtesy and assistance of Dr. Spencer of the Louisiana Experimental Station. Parasitised eggs were mailed to New York by aeroplane, placed in cold storage on a liner, and delivered in Barbados within 11 days of leaving Louisiana.

The colonies so obtained appear to be a different strain to that present in Barbados, and not only complete their cycle in nine days compared with ten taken by the local strain, but give a more uniform and higher parasitism in the laboratory.

So far, the maximum production and liberation of parasites has been between two and two and a half million a month. It is intended, however, to increase that output considerably for a minimum period of two months at the critical period of mid-July to mid-September. If the moth can be controlled then, much good will undoubtedly result. Next year, considerably larger liberations are planned. It must be emphasised, however, that it is too early yet to look for results. Considerable data has been obtained as to the prevalence, and seasonal incidence of the moth borer in Barbados, and of the loss suffered in the field and in the factory. It will be possible therefore adequately to check up the results of this work.

Present indications show that where liberations of the parasites have coincided in the field with a cycle of moth emergence and egg deposition a most satisfactory parasitism, and consequent destruction of moth borer eggs has followed. It is recognised that many, if not most of the liberations during past months, will have failed to coincide in this manner, with resultant wastage of parasites; but the policy of continuous liberations, culminating in a timed maximum effort, should stand a considerable chance of success.

Method of Distribution.

The Island has been mapped out into three areas of distribution starting from the windward side. Planters are invited by circular letter to call on specified dates each week to receive consignments of parasites. Each consignment of 12,000 is deemed sufficient for 15 to 16 acres of young cane, and instructions are provided to the effect that one slip (as previously described) of parasitised eggs is to be placed in every tenth stool, the rows being worked in chess board fashion, as shown on a diagram given with the instructions. Fields are to be treated so that wind will assist in distributing surplus, or successive broods of parasites, to neighbouring fields or estates. In this manner it is planned to secure a fairly even and simultaneous distribution, and to cover the entire Island once every three weeks.

The nature of the cane pest, the breeding of its parasite, and the method of distributing it, are explained in every badly infested Parish in the Island by means of lantern lectures advertised in advance. At the same time, the necessity for co-operation on the part of the planting community, with the Department of Agriculture, and the necessity for perseverance is strongly emphasised. The extent of their losses through insects is also brought home to them, and public opinion as to the advantage and necessity of combating insect pests is being aroused.

Losses Caused by *D. saccharalis*

Estimates have been made in various factories throughout the Island, of the extent of the damage due to moth borer, and as to the loss consequent thereon; gangs have been put on to sorting, counting and weighing random samples of 200 canes taken from loads of cane as they are ridden into the factory yard.

Estimates have also been made in fields of standing cane of the loss due to canes killed outright, or caused to rot, through the work of the borer; and it is considered that at least 20 per cent. of the crop is rendered unreapable, and that the canes reaped and delivered in the factory yard suffer a further minimum loss of 5 per cent. in weight. An average of 55 per cent. of canes were found to be badly bored, 30 to 35 per cent. slightly bored, and only 10 to 15 per cent. unbored. This is quite apart from loss due to deterioration in purity of juice of bored canes.

To obtain reliability and exactitude for such estimates would necessitate more work than has been possible under the circumstances, and would require a repetition over two or three seasons, which owing to the nature and necessity of the control work now in hand, is obviously impossible.

It is considered, however, that the above estimate shows the average loss sustained over the major portion of the Island in 1927-8. It is not claimed that insect control will entirely eliminate this loss, nor is absolute control ever expected. It is, however, anticipated that an economic control can be obtained, which should yield sufficient increase to counteract the present depression in the sugar industry.

It is further intended to follow up this work by introducing and establishing, if possible, larval and pupal parasites of *D. saccharalis* from other countries.

Cane Root Borer.

Diaprepes abbreviatus, Linn.

The control of this pest can only be lightly touched upon; details would in any case make the present article too long.

This pest is very serious in certain localities of the Island, and causes losses which experienced planters estimate at five to six tons of cane per acre. It is therefore planned to endeavour to control it at the same time as the moth borer, in order speedily to secure the necessary relief.

No new measures are advocated, but the procedure now being adopted is to educate the planting community by means of the lantern lectures mentioned, to differentiate between various cane insects and their life histories, and to recognise the beetle which is to be collected, and the best time for collecting it.

Further, the Department is organising the planters in infested areas into solid blocks of plantations pledged to collect and destroy newly emerged beetles, and to collect egg masses and dig up and destroy grubs as far as is possible.

It is planned to organise a lecture or lectures to school teachers, whereby requisite information can be disseminated through school children.

By these means it is hoped to secure a sustained co-operative campaign against the beetle this year, and the measures recommended, though simple, have every chance of success in a well populated, intensively cultivated Island area, which is naturally protected from re-infestation from neighbouring states or territories.

EAST AFRICAN SISAL.

There was an increase of about 4,000 tons, or 8%, in the exports of sisal from British East African territories last year. Tanganyika Territory, the source of two-thirds of the sisal grown within the Empire, exported 36,186 tons, compared with 33,012 tons in 1927. Kenya's exports were 16,516 tons against 15,839 tons. The figures for Nyasaland are not yet available, but were probably in the neighbourhood of 1,000 tons, compared with 801 tons in 1927. The total exports of sisal from British East Africa may, therefore, be taken as approximately 53,700 tons, against 49,652 tons in 1927.

Last year's exports were almost two and a half times as large as those of 1923, so that the industry has made good progress in the past five years, and now supplies nearly a quarter of the total world production of sisal. Helped by the enhanced demand for binder twine caused by the large grain crops reaped last autumn and by the growing of the fibre for rope and cord making, sisal prices advanced substantially during the latter part of last year. The outlook can therefore be regarded as satisfactory for those engaged in this important plantation industry. — (*Times Trade and Engineering Supplement*, Vol. XXIII, No. 557.)

TOBACCO INDUSTRY IN MAURITIUS.

By G. Corbett,
Tobacco Officer.

1. Tobacco has been cultivated in Mauritius for a large number of years, but the cultivation did not assume any importance until the year 1917 when, after experiments had been carried to a successful conclusion by the Department of Agriculture, a Government Tobacco Factory was inaugurated for the manufacture of the black shag tobacco which at that time was imported in large quantities from the neighbouring Island of Reunion. Prior to this the cultivation of tobacco was only allowed on the payment of a tax of Rs. 160 per acre, which had the effect of prohibiting any extensive cultivation. On the inauguration of the Government Factory a permit system was introduced, whereby growers were allowed to grow tobacco free of tax providing that they sold their produce to the Government Factory.

2. At the same time there were one or two Chinese Factories operating but not on any great scale. All the factories were manufacturing a black shag type of tobacco by the peculiar method known as carotting, a method similar to that used in the manufacture of Perique. The operation of carotting consists first of all in allowing the leaves to wither for a period varying between 12 to 15 days on racks in a well ventilated shed. The air dried tobacco thus obtained is subsequently moistened, the principal portion of the mid-rib removed and the leaves are then made up into small twisted packets or "Rouleaux" and the rouleaux are subsequently packed into carottes. A carotte is a torpedo shaped bundle weighing eight to ten kilos, covered with a wrapping of dried banana leaves known as "empondres" and then wrapped tightly with cord usually made of dried plaited aloe leaves.

3. The subsequent treatment of the carottes consists in undoing the cord periodically and rewinding, considerable pressure being exercised during the process. The operation of recarotting is performed at intervals gradually increasing in length, during the process of curing which takes from one to two years.

4. The process of fermentation which the leaves undergo in the carotte appears to be one of slow oxidation in the presence of limited amounts of air. The products of oxidation include apparently small quantities of butyric acid and other organic acids, and the presence of these accounts for the peculiar and markedly characteristic odour possessed by tobacco prepared in this way.

5. The method of fermentation has been modified to some degree, and instead of performing the carotting operation, a number of manufacturers now do it by placing the tobacco in a press where it remains for a shorter period than in the carottes.

6. The type of tobacco grown for this purpose was introduced from the Island of Réunion, and is a rather heavy tobacco, known as "Tabac Bleu."

7. The industry gradually developed on these lines during the years up to 1924, when it was decided to conduct experiments with other types of leaf, especially bright cigarette. These experiments appeared most promising and it was therefore decided to despatch an officer to study the methods employed in South Africa and Rhodesia. On the return of this officer further experiments were carried to a successful conclusion in the production of bright cigarette leaf, with the result that the years 1926 and 1927, witnessed very rapid changes in the tobacco industry, and the cultivation of the crop was taken up by some of the large estates, whereas previously it had been only carried out by the small growers. The law regulating the cultivation of tobacco was amended in 1926 and the cultivation was allowed to be free. An added impetus was given to the industry by the establishment of a tobacco factory by a tobacco firm, and they despatched a leaf expert to teach the growers the correct methods of cultivating and curing. Other factories were opened by various Chinese firms and locally manufactured cigarettes began to appear on the market to such an extent as materially to affect, in conjunction with the revision of the Customs duties, the import of manufactured tobacco.

8. During this period experiments were being conducted with a view to arriving at some conclusion as to the best varieties to be grown for producing the best leaf under the varying local conditions. The varieties which had been grown for years on the Island were found to produce a good coloured leaf but lacking somewhat in flavour, and therefore seeds of various Virginian varieties were imported for trial.

9. In the two years referred to above the acreage under tobacco increased from 300 acres to almost 2,000 acres and the present acreage is in the region of 1,500 acres, but the chief types grown are still the local varieties "Tabac Bleu" and "Constant," but other varieties such as Hickory Pryor, Yellow Pryor, Gold Leaf and "Amarillo" are gradually being brought in, for the purpose of producing bright flue cured leaf.

10. Samples of leaf despatched to brokers in London and also to the Imperial Institute received most favourable reports. As the local market is limited it is essential, if the industry is to become of any size, that an export market must be sought. With this object in view the samples above were despatched to London for report, whilst to prevent any tobacco finding its way on the home market which is of an unsuitable nature, regulations were enacted.

11. No tobacco of any kind is allowed to be exported unless it has been passed by the Government Grading Warehouse. This warehouse under the control and direction of the Department of Agriculture will either grade tobacco for export or will also export the tobacco. In the latter case, if so desired, an advance of not more than half the estimated value of the leaf will be granted to the grower, such advance to bear interest at the rate of 6 per cent. per annum. The charges against the leaf include the actual charges incurred plus 1 per cent. in the case of leaf just graded by the warehouse, and certain storage fees pending shipment, and in the case of leaf exported by the warehouse for growers ¼ per cent. commission is charged on all sales.

13. The production of leaf during the year 1928 was just over 310.000 kilos, of which 298,000 was sold and manufactured locally. The greater part of the produce was air cured, but flue curing is carried on, on an increasing scale every year.

14. Towards the end of 1928 a Committee was appointed to enquire into the difficulties experienced and the means of remedying same, and extracts of the report are annexed hereto.

Tobacco Committee Report

This Report was issued by a Committee whose terms of reference were to "enquire into the conditions of the tobacco industry in Mauritius, the difficulties experienced and their cause, and to make recommendations for establishing the industry on a sound basis, and overcoming its difficulties." It contains a brief resumé of the tobacco industry in Mauritius, already outlined above, but goes on to point out "that during the year 1926, the demand for leaf was far greater than the supply, which caused prices to rule very high and stimulated production. The grade of leaf which was produced at this period was of a very inferior nature, no care being bestowed on the curing. By the end of 1927, the supply of leaf had far exceeded the demand and a great fall in prices was witnessed, large quantities of leaf being unsaleable. The effect of this was to be seen in the considerably reduced area under cultivation during the early part of 1928. This was followed by a scarcity of leaf during July and August of that year, which again brought about a sharp rise in prices, which was again followed by increased acreage and a slight drop in prices. The increased acreage had not correspondingly increased the production owing to poor crops. At the beginning of 1928 a change from "Blue Tobacco" to "Gold Leaf" was witnessed with rather disastrous results to a large number of planters, the latter variety having failed through several causes such as: impure seeds, disease, bad cultural methods, bad seasonal conditions, &c." The Committee then state, that in their opinion, the industry is faced with the following chief difficulties:—

(1) The overproduction of a low grade leaf which does not obtain prices to enable tobacco cultivation to be carried on at a profit.

(2) The lack of information as to the best varieties to be grown, time of planting, manurial treatments, &c., and the lack of instruction.

(3) The lack of any system of co-operation for the marketing of the produce, which is essential for the purpose of stabilising the market and preventing the vicious circle of alternate gluts and scarcities.

The causes of these difficulties and the means of overcoming them and so placing the industry on a sound basis are then dealt with. Of particular interest is a tabulated statement which shows "that tobacco is chiefly grown in areas too small to allow of a sufficient quantity of leaf being obtained for curing, and that air curing must of necessity be the chief means of curing for these small growers." Further, it is pointed out that the chief factors necessary for success is that areas should be extended in some cases where flue curing is attempted.

With regard to the recommendations made it is initially stated that their full effect will not be felt "unless the planter in the first place is prepared to do his part by proper cultivation, by the planting of a sufficient acreage to enable sufficient leaf of the same stage of ripeness to be harvested, and by more careful handling of the crop." The recommendations confine themselves to two main points: the extension of experimental areas and the necessity for the formation of a central marketing organisation. The recommendations under the first head are summarised as follows: "We have arrived at the unanimous conclusion that the experimental areas should be extended and that the tobacco experiments should not be considered as a separate entity but should be run in conjunction with other experiments; and that the instructional facilities should be extended so as to assist the planter in the production of better quality leaf, as we consider that it is only by these means that an improvement will be effected." With regard to the second point the Committee recommended that as the tobacco crop in Mauritius is produced by growers on a small scale, many of whom are illiterate and do not understand the advantages to be gained from co-operation, that any organisation for bringing about the stability so much desired, should, of necessity, be compulsory. The proposals for the formation of such an organisation which would be in a position to standardise grades, control or regulate the supply of leaf according to the needs of the market and according to the export requirements was submitted to the local planters and generally agreed to. In paragraph 34 of their report the Committee state "We consider, therefore, that a central market organisation should be formed on the lines put forward by Mr. Corbett in a paper on 'Central Grading and Marketing Organisation.'"

Central Grading and Marketing Organisation.

According to Mr. Corbett the advantages to be gained by the planters through the formation of a central agency would be: reduced marketing costs and a proper grading of products, while a position of stability could be maintained by regulating sales according to the needs of customers. Such an organisation should be in a position to have complete control over the supply of leaf. In Mauritius it is stated that high grade leaf which is at present sold at prices far below its real value, is not required for the local market as the chief tobacco consumed is the very cheap brands of cigarettes and shag tobacco produced by the Chinese, while the best locally made cigarettes mainly consist of middle and low grade mediums. To control the marketing of leaf, supply the local market with what it actually requires, obtain expert advice on prices, and export the higher grades of tobacco, some central organisation is therefore absolutely essential.

The actual scheme provides for the renovation of a Government warehouse which although not ideal could with certain alterations, additions and necessary equipment, be made large enough to handle and store 100,000 kgs. of tobacco at one time. The management of the warehouse is to be vested in a Committee consisting of five growers, representative of all sections, and two officials, and the Director of Agriculture as Chairman. To control the warehouse a Manager, possessing a good knowledge of field work, is to be appointed with an overseer assistant and two clerks. With such a staff it is anticipated that the total cost of handling 300,000 kgs. should not exceed 10 to 15 cs. per kilo.

The leaf on receipt at the warehouse would be assigned to its various grades, the grower credited, and the warehouse would buy the leaf according to grades at prices fixed by the Committee. The leaf would then be pooled with the leaf of same grades from other growers. At the end of every half year or year, the profits made by the warehouse would, less a certain percentage for reserve fund, be paid out to growers as a bonus, according to grades of leaf supplied by the grower.

BRAZILIAN ALOE.

The "Brazilian aloe" is a hybrid of the Mexican variety, "hennequen," and is cultivated for its fibre which is of a better quality for industrial use and more easily extracted than that of "abaca." It is used for the making of rope, cloth, sacking, carpets, &c. Its cultivation requires a non-acid soil, containing upwards of 18 per cent. lime and less than 1 per cent. nitrogen. A dry climate is preferable with little precipitation. Two years are required on an average for the plants to attain full growth, then they will produce continuously for 16 years at the rate of two crops a year of 15 leaves per plant. The yield varies between 7,500 and 9,000 kg. per *alqueeir* (=2.42 ha).

The fibre measures 1.3 m. in length and has a resistance of 750 gm.; it contains 98.5 per cent. cellulose and 1.5 per cent. mineral matter. The fibre is separated by a machine of 30 h.p., capable of dealing with 300,000 to 400,000 leaves in 10 hours.

The waste matter is utilisable as a fertiliser and also for the manufacture of industrial alcohol.—(*International Review of Agriculture*, Year XIX, No. 12.)

AGRICULTURAL RESEARCH.

Information has come to hand with regard to a number of actions recently taken on the recommendations of the Imperial Agricultural Research Conference, 1927.

1.—Chain of Research Stations.

The question of the establishment of a station in North Queensland is under the consideration of the Commonwealth Council for Scientific and Industrial Research. The Committee on the organisation of a Colonial Agricultural Service have recommended that until the staff of the East African Agricultural Research Station at Amani had been brought up to full strength, no further central research stations should be created, although the establishment of further stations will be considered in due course by the Colonial Advisory Council of Agriculture and Animal Health. The Empire Marketing Board has approved in principle of a capital grant of £10,000 and an annual maintenance grant of £11,000 for five years, to the Onderstepoort Station, South Africa, to function as a central research station in animal diseases.

2.—Interchange of Information.

The question of the establishment of Imperial Agricultural Bureaux in Great Britain for the interchange of information among agricultural research and other workers in the Empire, was discussed at a Conference of Empire representatives which met in London in November, 1928. A scheme for the organisation of eight bureaux to be financed from a common fund made up by contributions from the Empire Governments and providing £20,000 a year for the next five years was worked out, and an independent "Executive Council" under the Chairmanship of Sir Robert Greig set up. The "Executive Council" decided to start the Bureaux for Animal Nutrition (Aberdeen) Animal Genetics (Edinburgh) and Fruit Production (East Malling) as from 1st April, 1929; those for Soils (Rothamsted) and Plant Genetics (herbage plants) Aberystwyth, from 1st May, 1929; those for Animal Health (Weybridge), Plant Genetics (Cambridge) and Agricultural Parasitology (St. Albans) in the summer as contributions are assured. The Empire Marketing Board has undertaken the responsibility for the publication for a limited period, of an Empire Journal of Dairy Research. The first list of new and useful publications dealing with the preservation and transport of foodstuffs, will be issued shortly by the Department of Scientific and Industrial Research. A list of agricultural research workers has been supplied to all workers whose names appear in the list. With regard to conferences, the Pan-African Agricultural and Veterinary Conferences will be held in Pretoria in August, 1929, while the second West African Agricultural Conference is to be held in the Gold Coast in October, 1929.

3.—Other developments.

Amongst some of the other developments the following are mentioned: the establishment of a Colonial Advisory Council of Agriculture and Animal Health, a scheme for colonial veterinary scholarships, the consideration of practical steps that should be taken to secure the development of the teaching of biology by co-operation between Universities and Secondary Schools, and the question of developing the Edinburgh University Animal Research Department as a centre for animal genetics work. Soil and plant pathology problems have been brought to the notice of those concerned. A Virus Disease Committee has been formed. It is proposed to hold the Third Imperial Entomological Conference in London in June, 1930. A Committee of chemists and biologists has been formed by the Ministry of Agriculture to report as to the action required to carry into effect the recommendation of the Conference "that investigations should be made into the whole chemical field of insecticides and fungicides by chemists working in collaboration with entomologists and plant pathologists," while the question of the World Agricultural Census of 1930-31 has been brought to the notice of the Governments of the Empire.

THE AMERICAN COTTON CROP.

The Department of Agriculture of the United States Government has now issued the final figures relating to the cotton crop for 1928. The area planted is now given as 46,946,000 acres, against 41,905,000 acres, the revised figures for 1927. The area picked is given as 45,341,000 acres, against 40,138,000 acres in the previous season. The yield per acre has been returned at 152.9 lb., against 154.5 lb. for the previous year. The total production is given as 14,478,000 bales, as compared with 12,955,000 bales in the previous season. The Department has published some interesting statistics with regard to the causes that reduced the yield. In this connection it is pointed out that in 1928 the boll weevil was responsible for 14.1 per cent. against 18.5 per cent. in the previous year, and 7.1 per cent. in 1926. The figures for excessive moisture are 7.3 per cent., against 4.9 per cent. in 1927 and 3.2 per cent. in the previous year, whilst the figures for deficient moisture are 4.4 per cent. for 1928, 6.4 per cent. for 1927, and 5.3 per cent. for the previous year. In market circles there has not been any great amount of interest in these statistics, as the attention of traders is now centred on the prospects for the new growth. Although no official information is yet available, it is agreed in most quarters that the crop has made a good start, and owing to the probability of a fair increase in the acreage the yield should be larger than last year, but a great deal will depend upon the weather during the next two or three months.—(*The Economist* Vol. CVIII, No. 4,474.)

TROPICAL WORLD NOTES.

The Leeward Islands.

According to Colonial Report No. 1419 for 1927-28, the total value of the imports of the Leeward Islands for 1927 amounted to £854,316 as against £842,464 in 1926, while the exports were valued at £987,229 as against £689,113 in 1926.

Antigua.

From an agricultural standpoint the year 1927 was a most favourable one, the output of sugar amounting to 23,195 tons, being the largest since the central factories have been erected. Of this the Antigua Sugar Factory, Limited, produced 19,794 tons at 9.2 tons of cane per ton of sugar, and the South-Western Estates Company, Limited (Bendals Factory), 3,401 tons. Very little muscovado was produced during 1927, only one factory operating, the sugar from which was consumed locally.

The acreage under cotton was practically the same as in the previous year. The total crop produced was 116,400 lb., of which 97,000 lb. valued at £9,276 was exported. This yielded 310,400 lb. of cotton seed, of which 60,480 lb. were exported to Montserrat to be converted into refined cotton seed oil—the balance was converted into cotton seed meal for local use. As mentioned in the previous year's report, the same arrangements were made with the cotton factory to purchase this seed cotton from peasants at a flat rate—this purchase being financed by the Antigua Cotton Growers' Association, which subsequently distributed a second and final payment to peasants after marketing it to the best advantage; this second payment amounted to over £200.

There has been a general increase in the amounts exported of onions, concentrated lime juice, green limes and distilled lime oil and these industries are gradually being extended.

There is little or no improvement to report in the coconut industry from the estates point of view; the older trees are slowly recovering from the effects of severe dry weather in the past.

Of other agricultural products mango plants of stringless varieties and avocado pears have been distributed to the peasants free of cost with a view to the increasing of the local supply of better-class fruit. The area under pine-apples is slowly increasing, as also bananas.

St. Kitts-Nevis.

The cane crop reaped was the largest on record for many years. The total quantity of sugar made at the Basseterre Sugar Factory was 18,067 tons, which is 1,777 tons more than that made in 1926. The total acreage planted in cotton during the year 1927 was about 3,000 acres. In St. Kitts the yield of lint per acre was somewhat below that of the previous year on account of serious damage done to the crop by the pink boll worm. In Nevis the total quantity of cotton produced was 160,000 lb. of lint. The raising of live stock is becoming an industry of some importance to the Island of Nevis, and large areas are now devoted to the raising of cattle and mules. Efforts are being made to interest the peasants in Nevis in the growing of fruits and vegetables for the Canadian market.

Dominica.

The export figures for limes and lime products during the year 1927 show a drop of 4,000 barrels over those of the previous year. This is mainly accounted for by the unfavourable weather experienced throughout the year but more especially during the flowering periods, and also to an outbreak of root disease. The value of the lime products grown show an increase owing to the high prices realised. With the improved steamship facilities between the West Indies and Canada the future of the fruit trade is much brighter. More interest is being taken in the coffee crop, and the number of plants distributed by the Department during the year is considerable. The Arabian type is being taken up on plantations, the Robusta type being practically confined to peasant cultivation.

* * *

British Guiana.

The Administration Report of the Director of Agriculture for 1928 states that the year under review may be regarded as a successful one where production was concerned; there being marked increases in all the more important industries. Values, however, did not come up to expectations. Sugar exports amounted to 114,687 tons as against 114,632 tons in 1927. The average yield was two tons per acre. Rum and molasses exports increased by 88,803 and 196,011 gallons respectively. As in previous years the variety of sugar cane mostly grown in the Colony was D.625; small areas of other well known varieties were also grown. Although the area under sugar cultivation has considerably decreased in recent years production has been steadily maintained. Exports of rice amounted to 18,083 tons valued at $1,114,147 as against 11,497 tons valued at $723,871 for 1927. In spite of lower prices for the commodity a record production and export was attained. With regard to securing an adequate supply of rice seed for the needs of the Colony a station and seed farm will be established in the Essequibo district during the course of this year. Coconut products yielded 25 million nuts, eight million lb. of copra and 52,219 gallons of oil. The industry is still a neglected one from an agricultural point of view, little care being exercised in the establishment of new, and the maintenance of old plantations. Although acreage and production are showing remarkable expansion actual yields per acre are low compared with other countries. Exports of coffee, most of which is Liberian, were also higher than in 1927, but faulty pulping and drying of the produce is a serious drawback. Of the other industries mentioned, lime and

other citrus fruits, onions and tomatoes are promising, especially in the North West District where conditions appear to be favourable for their extension. The interest exhibited by small cultivators in ground nuts during the year was rather disappointing. Experiments at Cecilia, however, clearly indicated that as a peasant industry under sand reef conditions it possessed possibilities. Tobacco cultivation, especially of the heavy type is gradually being extended for local consumption. With regard to peasant agriculture the Director stresses the need for efficient co-operative organisations to finance production, and to prepare and dispose produce. In his general remarks he advocates better organisation and control of drainage and irrigation, and the improvement of the present uneconomic distribution of the Colony's agricultural population.

* * *

Rhodesia.

Mr. H. S. Hopkins, who spent the latter half of last year in England as a special representative of the Southern Rhodesian Government studying the prospects of that Colony's tobacco in the Home market, has presented a very candid report, in which he indicates the difficulties which operate against a rapid expansion of demand for Empire tobaccos. He points out that the distinctive flavour of Rhodesian tobaccos—and of all Empire tobaccos—is not generally acceptable to the public, whose taste cannot be unduly forced. This applies more particularly to cigarette tobaccos. Were it not for the Customs preference little would be used in Great Britain in competition with American leaf. The Home market is glutted with low Empire grades, which, in addition to having a detrimental effect on prices, has tended very naturally to give Empire tobaccos a bad name with the smoking public; so much so that the bulk of the Empire brands are not looked upon with favour. They are sold largely on account of difference in price.

The present unsatisfactory state of the industry is attributed to :—

1. Over production which, though but a bagatelle compared with the quantity imported from America, has unfortunately proved in excess of that which Great Britain is prepared to absorb.
2. The quantity of low-grade green tobacco shipped to this market which should never have been sent.
3. Faulty grading.
4. Faulty curing.
5. Indifferent packing.

Price depends largely on the ratio of supply and demand. All sound ripe tobaccos have a use in Great Britain, and at present there is a greater demand for the higher Rhodesian grades than there is for the lower. There is, however, no question that the lower grades are keeping down the prices of the higher. Manufacturers could undoubtedly pay a much higher price than that at which they are at present buying. Mr. Hopkins agrees with the opinion of manufacturers that the distinctive flavour of Rhodesian tobaccos will not permit of their being forced on the public, and that the cost of an advertising campaign with this object would be prohibitive, though he suggests that there should be a certain amount of Press advertisement. As to the outlook Mr. Hopkins considers that Southern Rhodesia unquestionably has a future which should enable the Colony to become one of the most important tobacco producers, if not the most important, in the Empire.—(*The Times Trade and Engineering Supplement*, Vol. XXIV, No. 561.)

* * *

Seychelles.

According to Colonial Report No. 1420 the total value of the trade of the Colony for 1927 (exclusive of imported specie) was Rs. 3,960,171, as compared with Rs. 4,063,478 in 1926. The total exports were valued at Rs. 2,159,918 compared with Rs. 2,376,031 in 1926. The coconut industry is the most important one in the Colony, the total exports of copra during the year amounting to 4,628 tons. Only about 12,500 coconuts were exported as against 83,900 during the previous year. After the copra industry, the distillation of essential oils holds the place of next importance in the Colony's industries. The distillation of cinnamon oil was continued energetically and increasing interest has been shown in the distillation of patchouli, basilic, lemon grass and clove oil. The total export of vanilla during the year amounted to 3,245 kilos, and of rubber to 9,694 kilos.

* * *

Fiji.

The exports from Fiji through the three ports of the colony, Suva, Levuka and Lautoka, amounted for the year 1928 to £2,701,251, as compared with £1,997,374 in 1927, according to a statement recently issued by the Customs authority at Suva. Sugar is by far the most important item, and last year showed a considerable increase, the quantity exported being 120,683 tons, valued at £1,827,095, compared with 72,753 tons. valued at £1,125,215, in 1927. The 1928 export of copra was 27,947 tons, valued at £567,254 (26,560 tons, worth £534,416 in 1927). The value of bananas exported fell slightly from £157,819 in 1927 to £147,781 last year, and trocas shell from £16,355 in 1927 to £14,669 in 1928. Rubber showed a serious decline both in quantity and value, exports last year being only 94,661 lb., valued at £4,704 compared with 221,238 lb. in 1927, valued at £15,276. Molasses were valued at £14,599, compared with £11,181 in 1927, and under the classification "other articles" there was a decrease from £137,112 in 1927 to £125,149 last year.—(*The Chamber of Commerce Journal* Vol. LVII, No. 794.)

SORGHUM VARIETY TRIALS.

[*The following note is published through the courtesy of the Tanganyika Department of Agriculture.*]

The sorghums have been divided into three types, and the object of the experiment has been to find the most suitable varieties in each type. The types are :—

(1) Heavy yielding — with a hard grain, suitable for storage or export.
(2) Heavy yielding—not necessarily suitable for storage or export. This class includes soft grained varieties.
(3) Early maturing.

The experiment has been conducted on these lines for three successive seasons. The details of the 1928 season are given below, together with a summary of the preceding years. The obviously inferior varieties included in the 1926 and 1927 experiments have been discarded.

Heavy Yielding Types.

All varieties were planted on 22nd December, 1927. This is the normal sorghum planting season. All the varieties suffered very severely from the six weeks drought after planting. In practical farming the crop would be regarded as a failure but the results are interesting as they give comparative yields under adverse conditions.

Variety.	*Yield per acre in kilograms.*	*Order of Yield.*
Bonganhilo	55	III
Kilinyali*	195	I
Ngwana Kwimba ..	85	II
Sukesha	30	IV
Kihemba-hemba ..	15	V
Karachi*	15	VI

As the conditions of the first planting resulted in crop failure a second planting was carried out on 16th February, 1928, just at the commencement of the heavy rains. The following table gives the results together with the comparative yields of the varieties in this experiment over three years :—

Variety.	*Yield per acre in kilos.*	*Comparative Yields.*		
	1928	**1926**	**1927**	**1928**
Bonganhilo ..	1,000	100	100	100
Kilinyali* ..	840	80	62	84
Ngwana Kwimba	540	67	54	54
Sukesha ..	430	87	52	43
Kihemba-hemba	100	not grown	42	10
Karachi* ..	70	19	1	7

6 other varieties discarded in 1928.

Early Maturing Types.

Thirteen varieties of quick maturing dwarf sorghums imported from the Sudan and the United States of America were grown on the station. Dwarf sorghums have been imported and tried on this station since 1924 without success. The object of the importation has been to give an early source of food, if possible growing the crop during the short rains. Every attempt to grow these sorghums early in the season has resulted in failure. In seasons where the early rains have been scanty the sorghums have made such poor growth that the yields have been negligible; in seasons where the early rain has been adequate for growth, flowering and setting of seed has occurred at the opening of the heavy rains, with the result that the heads have not set or have been so damaged by fungus diseases that no crop has been harvested. This season it was decided to try planting these quick growing sorghums at different periods to see if economic yields could be obtained at any period. Three plantings were attempted: the first in the short rains (21st December), the second during the rains (20th February) and the third towards the end of the rains (5th April).

All the yields have been so low that any attempt at giving a table of comparative yields would be misleading. Yields have ranged from nil to a maximum of 110 kilograms per acre, and the grain harvested has not been perfectly sound. The futility of these yields is shown when compared to the yield obtained from the variety Bonganhilo —1,000 kilos per acre.

* Hard grained varieties.

CANE RIPENING EXPERIMENTS.

In an article which appears in the *Hawaiian Planters' Record*, Vol. XXXIII, No. 2, Messrs. J. A. Verret, A. J. Mangelsdorf and C. G. Lennox, describe a cane ripening experiment carried out by the Honolulu Plantation Company with the co-operation of the chemistry, sugar technology and agricultural departments, Hawaii Sugar Station. The following summary is given:

" The experiment was located on a field situated at an elevation of about 250 feet, whose soil consisted of a red silty clay loam of fair depth. A series of ten plots distributed uniformly over the field was harvested at the beginning of the ripening period, twenty-five days after the final irrigation. A second series was harvested three weeks later, and so on. In all, seven series covering a period of four months were harvested.

At each harvesting, the following determinations were made for each plot, cane yield, Brix polarization and purity of the crusher juice. From these the quality ratio, yield of tons of sugar per acre and tons of sugar per acre per month were calculated. Per cent. glucose, P_2O_5 and K_2O in juice and per cent. fibre in cane were also determined. Soil samples from the first-, second-, and third-foot depths were also taken for each plot and their moisture and nitrate nitrogen contents determined.

The trends of the different values were as follows;

1. Yield of cane per acre increased slightly up to 44 days and remained practically constant thereafter.
2. Brix increased at first rather rapidly and thereafter more slowly.

3. Polarization increased rapidly up to 65 days, after which it declined gradually.
4. Purity improved up to 65 days, thereafter holding its level fairly constant to 90 days, when it began to decline.
5. Yield of sugar per acre increased rapidly up to 65 days, and more slowly up to 90 days, after which it declined.
6. Yield of sugar per acre per month increased rapidly up to 65 days after which it declined at first gradually, then rapidly.
7. Per cent. moisture in cane declined slightly and gradually.
8. Per cent. fibre in cane increased as ripening progressed, somewhat erratically, however, due probably to experimental error.
8. Per cent. fibre in cane increased as ripening progressed, somewhat erratically, however, due probably to experimental error.
9. Soil moisture declined to the wilting point, then rose again as a result of showers and finally declined once more to the wilting point.
10. Nitrate nitrogen in the soil first declined and then increased.
11. P_2O_5 and K_2O in the juice showed a slight and gradual increase, associated possibly with the slight increase in concentration of cell sap due to drying out.

It was concluded that under the conditions of the experiment the greatest returns in terms of sugar per acre per month are realized when the cane is harvested within 60 to 90 days after the final irrigation. Over ripening may result in loss of sugar, loss of growing time for the next crop, and injury to ratoons."

INDIAN SUGAR CROP.

The sugar crop of 1928-29 in British India is placed at 2,735,000 long tons of raw sugar (gur) in the final general crop memorandum published in the Indian *Trade Journal* Vol. XCII, No. 1181. This represents a decrease of roundly 15 per cent. from the 1927-28 crop, which reached 3,216,000 tons, and is the smallest crop produced in India since 1924-25.

The cane area for the 1928-29 crop is reported as 2,576,000 acres, compared with 2,952,000 acres in 1927-28, a decrease of 13 per cent., and the sugar yield per acre is estimated at 2,378 pounds, against 2,440 pounds the previous year.

The greatest reductions are shown in the United Provinces and Punjab, the principal producing sections, the acreages in these provinces showing decreases of 14 and 19 per cent., respectively. These decreases are attributed primarily to the low price of sugar, and, in the Punjab, a deficiency in the rainfall.

Production in other areas where sugar is produced on a small scale is estimated at 160,000 tons, being the average of these areas for the past five years.

CALCIUM CYANAMIDE.

The following summary of some recent work in India on the nitrification of calcium cyanamide (a fertilizer much to the fore at the present day), under the conditions that prevail in certain Indian soils, is taken from a memoir by Mr. J. H. Walton, Imperial Agricultural Bacteriologist, Agricultural Research Institute, Pusa. The Memoir is No. 3, Vol. II, Sept., 1928, of the Bacteriological Series, issued by the Department of Agriculture in India.

(1) In all but one of the soils examined, nitrification of sulphate of ammonia and of cake began before that of cyanamide. When cyanamide was added in quantities to supply 30 mgms. nitrogen per 100 gms. soil, some weeks always elapsed before nitrification began, and in Pusa soil even after twenty-six, in Cawnpore and Kalianpur soils, after twenty-nine weeks, nitrification had not begun. In the Ranchi soils, the better the soil, the quicker nitrification was in starting. In the Upland soil, it began after twenty-eight weeks, in the Intermediate soil after twenty weeks, and in the Valley soil it was just beginning after sixteen weeks, and was rapid in the next five weeks. In Chinsurah soil, vigorous nitrification did not begin till after the twenty-fourth week, but even after forty weeks less than half the added nitrogen was recovered as nitrate. In Kalol soil, nitrification started after the fifteenth week. In Sihar soil nitrification of cyanamide was most rapid. It started vigorously between the eighth and tenth weeks, and by the end of the fourteenth week, equalled that of sulphate of ammonia. The Karimganj soil is abnormal. Nitrification of the cyanamide started after the sixth week; 9.6 mgms, nitrate nitrogen were recovered by the eleventh week, and 20.1 mgms. by the twenty-fourth. When sulphate of ammonia or cake was added, there was practically no nitrification of either of them, owing to the acid nature of the soil. Correction of the acidity by liming enabled nitrification to take place readily with sulphate of ammonia and cake, but that of cyanamide had not started in eight weeks.

(2) When cyanamide was added in doses to supply 5 mgms. nitrogen per 100 gms. soil, nitrification began earlier than with 30 mgms. dose. In Pusa soil it was slow, but in four months, sixty per cent. of the added nitrogen was recovered as nitrate. In the Cawnpore and Kalianpur soils in which, with Pusa soil, there had been no nitrification of the 30 mgms. dose, sixty and forty-eight per cent. respectively of the added nitrogen was recovered as nitrate at the end of ten weeks. When 30 mgms. nitrogen per 100 gms. soil, are added to Pusa soil, half as cake or as ammonium sulphate, and half as cyanamide, the cyanamide prevents nitrification for several weeks. In Pusa soil of exceptionally high nitrifying power, in which 30 mgms. ammonium sulphate nitrified in a week, nitrification with

the 30 mgms. dose of cyanamide began by the first week, and went on slowly till nitrate equivalent to thirty per cent. of the added nitrogen was recovered after eight weeks.

(3) Cowie found no evidence of nitrification of dicyanodiamide after several months in some English soils, and that dicyanodiamide is toxic to the nitrifying organisms and stops the normal oxidation of ammonia in soils containing ammonium sulphate, as well as that of the ammonia produced from cyanamide. He found that the cyanamide readily broke down in the soil, yielding ammonia, which then nitrified in the usual way.

(4) The cyanamide used in our experiments with the Indian soils was free from dicyanodiamide, but nitrification with the large dose (30 mgms. per 100 gms. soil), was always retarded for some weeks, even in soils which nitrified cake or ammonium sulphate vigorously, and in which a large part of the cyanamide was recovered as ammonia after an incubation period of one week. The addition of cyanamide seems to give rise to some factor inhibiting the action of the nitrifying organisms in the soil, and until this disappears the normal nitrification processes do not begin.

QUEENSLAND COTTON.

IN an article which appears in the Queensland Agricultural Journal (Vol. XXX Part 5) the situation regarding cotton growing in that State is summarised as follows:

1. Excellent yields of cotton can be produced over a large area of country.

2. The favoured cotton country lies between the coastal and the Main Dividing Ranges and the valuation of much of this country is low in comparison with that of the more closely settled coastal areas. A considerable area of Crown land is also available in the districts suitable for cotton-growing.

3. Owing to the distance of these areas to markets for perishable produce, dairying appears to be the most suitable of the older established industries.

4. Cotton-growing combines excellently with the dairying industry—the cultivation period of the former occurring at such a time as to permit both industries to be practised in conjunction. An attractive feature is that the returns from cotton-growing are received during the period when dairy production is at its minimum.

5. The implements necessary for cotton production can also be used in the production of maize or fodder crops. By a combination of cotton-growing with these industries the overhead expenses are distributed.

6. The general average yield of cotton per acre is much lower than individual average yields of many experienced farmers.

7. The average yield per acre can be appreciably improved if more attention is paid to the selection of suitable types of soil for cotton-growing.

8. The general experience of cotton-growers is that early preparation of the seed-bed and planting as soon as possible after the soils have warmed up sufficiently to promote steady growth gives the best results.

9. Early planting appears to be conducive to the setting of a heavy crop before the "wet season" starts. A reduction of the possibility of loss from attack by the Corn Ear Worm (*Heliothis obsoleta*) seems to be associated with well-fruited early-sown plants.

10. The average grower uses a light rate of seeding under the belief that economies in the thinning operations will be obtained. It is believed that the loss of stand as a result of the adoption of this method more than counterbalances any initial financial gain secured through the limitations of the supplies of seed purchased.

11. The thinning and cultivating operations may be performed more efficiently and economically if the proper implements are used at the correct time.

12. The cost of production in Queensland must be reduced, and the increase of the yield per acre offers the easiest means to accomplish this result.

13. A Cotton Section has been developed in the Department of Agriculture and Stock, to assist the growers in the solution of problems connected with growing cotton in this State. Trained Field and Grading Staffs are actively engaged in the investigation of production and the proper preparation of the crop for marketing.

14. A Cotton Research Station has been established where detailed technical investigations can be made in such problems as the effect on the cotton plant of rotation with different crops, green manuring, cultural operations, and soils. Studies are also conducted in evolving and building up supplies of suitable strains of acclimatised seed.

15. A comprehensive system for the supply of plant seed of suitable acclimatised varieties has been developed for the whole of the cotton belt.

COTTON IN CEYLON.

IN an article on "Cotton in Ceylon" (which appears in the *Empire Cotton Growing Review*, Vol. VI, No. 2.) Mr. Stockdale says in his concluding remarks "It may be stated that there is no doubt that cotton can form a useful rotation crop in a system of agriculture suitable for the drier areas of Ceylon. Cambodia cotton can be satisfactorily grown, but early maturity types are required, and special selection of seed must be continued so that high yielding types suited to the conditions of Ceylon are secured. Attention has so far been concentrated on the Hambantota district, but a beginning has, during the past two years been made in other areas where cotton cultivation promises to be successful. The slump in cotton prices has introduced a complication in these trials, but so far the Government of Ceylon has met a part of this fall in values in order that a reasonably stable price to the growers may be maintained."

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

The Use of Fluoride for Cleaning Evaporator Tubes.

Mr. H. B. Springer sends us the following note with regard to the use of fluoride (*See* also T. Van Der Linden. *Inter. Sugar Journal*, Vol. XXV, December, 1923, page 637) for cleaning evaporator tubes in a factory at Berbice, British Guiana, where considerable difficulty was experienced in keeping the heating surfaces of the evaporators sufficiently clean to enable them to keep ahead of the mills. The analysis of the type of scale dealt with was as follows :—

	Per cent.
Moisture and loss on ignition ..	25.88
Silica SiO_2	27.74
Phosphate P_2O_5	1.23
Sulphate SO_3	11.78

An attempt was first made to determine in the laboratory the minimum concentrations of sodium fluoride and ammonium hydrogen fluoride, which would have what was considered sufficient softening action on the scale. This was done by removing a tube from the fourth vessel of a quadruple—and one from the third vessel of a triple—effect evaporator. The tubes were cut into 2-inch lengths, and the sections thus obtained boiled for 3 hours with 1, 2, 3, 4 and 5 per cent. solutions of each of the re-agents mentioned. From the results of these tests, it was decided that 2 per cent. ammonium hydrogen fluoride was the best suited, and most economical, for the purpose. The concentration of sodium fluoride required to produce a similar effect was 5 per cent.

In practice, it was found necessary to boil only the last effects of both triple and quadruple evaporators every week, and the third effect of the quadruple once in three to four weeks.

The following procedure was used with good results :—

Fresh 2 per cent. ammonium hydrogen fluoride was boiled for three hours, under one inch of vacuum to produce circulation, in the effect to be cleaned, and run into a storage tank.

Better results would undoubtedly be obtained by boiling under pressure ; but this would necessitate large and expensive valves on the vapour pipes of the penultimate effects.

This used solution was made up to two per cent. concentration with new re-agent for use the following week, reboiled and returned to storage. At the end of the third week, new 2 per cent. solution was used on the last vessels, and the partially spent reagent boiled in No. 3 quadruple.

The loss during the boiling process described was approximately 60 per cent. of the initial fluorine.

In all cases, the vessels were filled with water after boiling, and scraped wet. The scraping was greatly facilitated, and comparatively large quantities (100-120 lb.) of softened scale removed from each of the last calandrias.

The last used solution was found to be useless for further boiling, but was run into a separate storage tank, in which thus accumulated the spent reagent from each cycle. This solution was utilised with very good results at the end of the grinding season being drawn into all the effects, and allowed to stand for two months or longer before hand cleaning was commenced. Any resulting surplus may be diluted and used with advantage on the pans.

The cost of cleaning was increased by $20 a week by the use of ammonium hydrogen fluoride ; but this extra cost was more than counterbalanced by an increased evaporative capacity of about 25 per cent. and the consequent elimination of "Juice Room" stoppages on the mills, and increase in maceration. The steam efficiency of the factory, also, was improved, since less steam had to be used in single effect, and the various power units operated against a lower back pressure. It would be expected, also, that the life of the tubes would be lengthened.

* * *

Filter-Cloths.

Among the causes which lead to the damaging of cloths as used in filter-presses are the following : rust on the edges of the filter-press frames ; carelessness in dressing leading to unnecessary stains ; cloths remaining too long in the frames ; addition of soda to juices or wash-waters ; and washing the cloths with dilute acid, or in machines which injure them. A cloth has recently been put on the market which possesses a border of double strength and this is stated much to reduce cloth consumption. The cost of filter-cloths per ton of roots in Holland is said to amount to 2.1 to 6.5 Dutch cents. (1).—(*Int. Sug. Jnl.*, Vol. XXXI, No. 365.)

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Sucrose.

W. D. Helderman, two years ago, obtained some physical constants which seemed to show that a second modification of sucrose exists having a different density and heat of solution than ordinary sugar. (2) Now, however, the distinguished Swiss chemist, Prof. Pictet, and his assistant H. Vogel, (3) on examining these claims, bring evidence to show that the so-called second modification does not exist, and that there is complete uniformity in respect of constitution and configuration between sucrose as crystallized by Helderman and that generally known.—(*Int. Sug. Jnl.* Vol. XXXI, No. 365.)

(1) Caals : *Tijdschrift*, 1928-29, No. 7.
(2) *Int. Sug. Jnl.* 1927, 633.
(3) *Helvetica chim. acta*, 1928, 5, 901 ; through *Cent. Zuckerind.* 1928, 36. No. 49, 1362.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The British Nitrogen Industry.

The annual report of the British Sulphate of Ammonia Federation, just issued, gives an interesting survey of the world nitrogen position. As bearing on the vital relation of increase of production to increase of consumption, it is interesting to learn that during the year production increased 34 per cent. and consumption 22 per cent. If the increase continues in anything like the above ratio, it is easy to foresee a serious condition of overproduction, with its inevitable effect on prices. In this matter much depends on Chilean nitrate policy, which is being watched with great interest. If developments in Chile are on a large scale, the overproduction problem may become serious. It is argued, however, that new synthetic plants are not likely to multiply very rapidly in the present circumstances, while the potential consumption goes far beyond the present figures. The tropical countries are regarded as great markets for the future, and in the British colonies the interest in nitrogenous fertilizers is rapidly increasing as the result of systematic propaganda. Recognised authorities on synthetic nitrogen express complete confidence in the future of the industry. At the great Billingham-on-Tees works, extensions are still in progress. It is worth recalling that at the annual meeting of Imperial Chemical Industries, Ltd., Lord Melchett rather ridiculed the idea of failing to find markets. He appears to be convinced that consumption is still capable of almost indefinite expansion.

The price factor continues to engage anxious attention. The present export figure in Great Britain for ammonium sulphate of best neutral quality is about £9 10s. per ton or a little higher. This represents a very considerable decline from the standards of the last ten years. In 1919-20, for example, the price stood at £23 15s. Sir D. Milne-Watson the chairman of the federation and the governor of the Gas Light and Coke Co., frankly admitted that the price level for last year, which is to be maintained for 1928-29 is not satisfactory to the by-product producers, but with equal frankness he added that they would be deluding themselves if they counted on any improvement in the price.

Apart from price, the export demand for British sulphate of ammonia is most encouraging. In the last two years the exports to Spain, Portugal, and the Canaries have increased from 50,944 to 85,050 tons, Java from 4,293 to 29,610 tons, Japan from 37,667 to 100,915 tons, China from 24,206 to 49,800 tons, West Indies and Mauritius, from 8,917 to 14,800 tons, India and Ceylon, from 4,500 to 11,291 tons, South Africa (a new market), from 353 to 1,694 tons.—(*Industrial and Engineering Chemistry*, News Edition, Vol. VII, No. 1.)

Perfection of Artificial Silk.

In an address on artificial silk in the early part of October at Frankfurt a/M, L. Kirberger, of the I.G. Farbenindustrie A.-G., pointed out that nitro silk is no longer produced in Germany, whereas, in 1926, 7 per cent. of the production was nitro silk, 2 per cent. copper silk, 3 per cent. acetate silk, and 88 per cent. viscose silk. The production of acetate silk is constantly increasing. Its advantage lies in its lower specific gravity and its applicability for making mixed fabrics, because, on account of its special dyeing characteristics, acetate silk permits the production of variegated effects without the use of variegated webs. Artificial silk at present is used in human clothing to the extent of only 2 per cent. Of the total production 46 per cent. is used in the tricot industry; 26 per cent. for cotton mixtures; 16 per cent. in silk weaving; and 12 per cent. for other purposes. The world production amounted in 1927 to 120 million kilogrammes, of which one-third entered into the manufacture of stockings. Thirty to forty pairs of stockings can be made from a kilogramme of artificial silk. Its use, on the contrary, for sewing thread is not yet possible. The price of a kilogramme of viscose silk is 7 to 13 marks, Agfa-Travis silk 14 to 17 marks, Bemberg copper silk 20 marks, and natural silk 60 marks—(*Industrial and Engineering Chemistry*. News Edition, Vol. VII, No. 2.)

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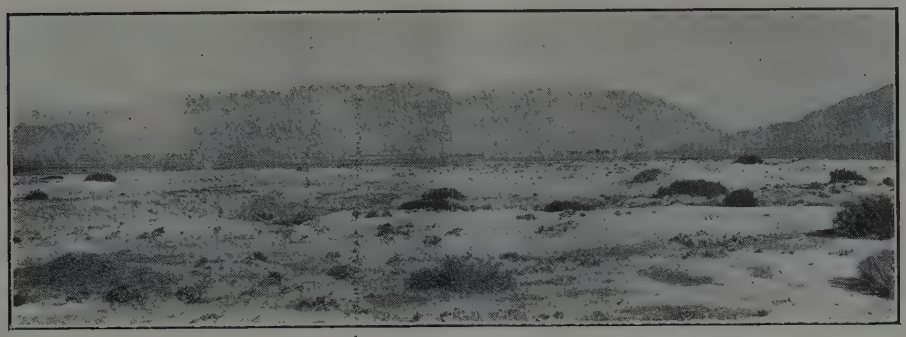
Banana Pectin.

In the *Fruit Products Journal* (Feb., 1929), Dr. von Loesecke further describes his attempts to extract pectin from banana peel. The pectin content of fresh peel ranges from 0.7 to 1.3 per cent. It is slightly less than this in the pulp. There is just as much pectin in green banana peel as in ripe yellow peel, but its jellying power is very low, and extracts of it contain an excess of undesirable starch. Best results were obtained by using citric acid (0.2 per cent.) as extracting agent. The minced peel is heated for one hour nearly at boiling point with the acidic solution. The filtered, cooled extract is then treated with maltose broth, containing the fungus, *Aspergillus oryzae*, which removes starch. The liquor is then clarified with Filter-cel, and concentrated *in vacuo*. The pectin syrups unfortunately showed dark colours. They yielded on evaporation to dryness, a solid product, representing some 4 per cent. of the weight of the peel taken. This was also dark coloured, and rather hygroscopic, both of which are great commercial drawbacks. Unfortunately also, the jellying power of the product was not so high as that of apple pectin, nor were its keeping qualities satisfactory.

Evidently, further investigations are necessary before a suitable pectin preparation can be put on the market as yet another product of the valuable fruit of the banana.

AGRICULTURE IN NORTH AFRICA.



7. *The Grand Atlas.*

8. *Holly Oak. (Quercus Ilex.)*

9. *Two Oases in the Oued Souf.*

AGRICULTURE IN NORTH AFRICA.

10. *Roots and branches of Ephedra, Ratam and Tamarisk on sale at the Oued Souf market.*

11. *Date Palms.*

12. *Olive trees on the slopes near Fez.*

REVIEWS.

THE GEOLOGY OF VENEZUELA AND TRINIDAD. By R. H. Liddle, *MacGowan, Fort Worth, Texas*, 1928. pp. 552; (With Bibliography (5 pp.) 83 plates, 21 diagrams, and 1 geological map).

In the Preface, it is stated that, prior to the compilation of this book, no systematic outline of the geology of the north-eastern part of the Spanish Main had been attempted. The area was studied by the writer in 1920-25. He acknowledges indebtedness to numerous oil geologists for help, and to the Pure Oil Company for allowing access to its detailed reports on Venezuela.

The first part of the book deals with Venezuela; the second, with Trinidad. This latter section (90 pp.) presents a concise description of the distribution of the various metamorphic and sedimentary rocks within the Island, and describes its structural and economic geology. The main lines are similar to those followed by G. A. Waring in his memoir, published in 1926 by the Johns Hopkins Press, with the exception that Liddle stresses the importance of the sandy Matura formation (Pliocene), which he believes to be represented, not merely in Matura Bay near Balandra, but over a wide area within the Northern Basin.

By far the greater part of the book is devoted to Venezuela. The physiography of the Guayana Highlands, the Llanos, the Delta Region, the Maracaibo Lake Basin, the Falcon Watershed, the Venezuelan Andes, the Coast Range, and the Caribbean Islands (Curacao, Aruba, Margarita, Tortuga, &c.), is separately described in nine chapters. A discussion of geology of these areas then follows. This is arranged under igneous and sedimentary rocks, and the latter are considered in stratigraphical succession. The amount of detail is very great, but the subject matter is very readable. The geological map is unfortunately not a coloured one, but, in order to avoid the use of an exhaustive legend, a correlation chart has been placed on it, so that this objection has been largely overcome.

F. H.

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THE ART AND SCIENCE OF CULTIVATION.—*Ernest Benn, Ltd.*

This booklet contains papers read at a Conference attended by farmers, implement and tractor manufacturers, and scientific workers, at Rothamsted, to discuss the practice of spring cultivation in different districts of England. Views on the value and practice of successful cultivation from the point of view of maximum crop output and economic returns, are expressed, and followed by a general discussion.

A summary of the papers, and opinions expressed, is given by Mr. C. Heigham late of the Rothamsted Experimental Station.

D. B.

1. SUCCESS ON IRRIGATION PROJECTS. J. A. Widtsoe, PH.D., LL.D., *J. Wiley & Sons. Inc.* pp. 153.
2. USE OF WATER IN IRRIGATION. S. Fortier, D.SC., *McGraw-Hill Book Co., Inc.* pp. 420.
3. THE THIRSTY EARTH. E. H. Carrier, M.A., M.SC. *Christophers.* pp. 222.
4. THE PRINCIPLES OF UNDERDRAINAGE. R. D. Walker, M.C., A.R.C.S., D.I.C., *Chapman & Hall, Ltd.*, pp. 223.

THE problems of irrigation and drainage are many and varied. Each of the above books deals more or less completely with a different aspect of the subject, and so different are the points of view of the authors, that they scarcely overlap.

The problems which interest the administrator, the need for adequate protection of the water supplies of a country and care in granting out water rights, are dealt with by Dr. Widtsoe in his excellent little book, which is a brief, non-technical recapitulation of the main principles which should guide such action. The careful estimation of the water available, the selection of the site for the project, the disposal of the land to the right type of settler, and his financial assistance, under proper control, during the initial period, are all carefully discussed, and their relative importance appraised. Dr. Widtsoe draws a most interesting series of conclusions from the success which attended the Utah colonization of 1847, which he embodies in a summary of six requisites of success.

The second book, as its title indicates, deals with the most important of the problems of irrigation, the actual use of water in the field, and the selection of the crops to grow with it, and Dr. Fortier's wide practical experience makes his book a valuable one. He writes alike for the new settler and for the agricultural student, and has produced what he himself calls "An Irrigator's Handbook." The treatment throughout the first six chapters is careful and thorough; the last chapter, which deals with the use of water in foreign countries is of less value, and will be more difficult to keep up to date. This is the third edition of an admirable work, which may be thoroughly recommended.

In "The Thirsty Earth" the author has produced a work which should prove interesting to the non-technical reader, as he describes in a rather popular way the geographical conditions of the various countries in which irrigation is practised, and the extent to which water is utilised for agriculture. The book also contains a separate section dealing with the Irrigation Empires of the Ancient World.

The last book presents the engineering side, and applies especially to the Malay States, where the author seems to have acquired most of his experience. Full directions and costs are given for laying tile drains for the purpose of anti-malaria measures, or for the prevention of slip in railway cuttings.

R. C. W.

SUGAR-CANE AND ITS CULTURE. By F. S. Earle. London: *Chapman and Hall, Ltd.*, 1928. pp. 355. Price 22*s*. 6*d*.

This issue is a valuable addition to the text books on sugar-cane. It is divided into two portions, the first of which deals with the plant itself, and the second with its cultivation and both sections are adequately illustrated. The first chapter deals with the history of cane as a cultivated crop, and brings out clearly how from its origin in the East, the plant has spread all over the world. Indiscriminate introductions and haphazard methods of cultivation in the early stages brought the natural sequence of disaster in the shape of diseases and pests and these calamities have resulted in great improvements. New varieties have been sought and new canes raised by hybridisation to meet the needs of the situations that arose as the result of the old types of canes succumbing to disease. An excellent example of the triumph of the plant breeder is quoted by the improved canes that are now being grown in Java and which are the logical sequence of the devastating outbreak of that complicated disease "Sereh" in the early eighties. An annotated list with descriptions is given of most of the important varieties now cultivated, and also of the chief cane diseases and pests. Each of the latter accounts is accompanied by a brief bibliography which should prove of value to students. One is inclined to disagree with the author, however, in his account of the Froghopper Blight of Trinidad that the punctures of the insect (*Tomaspis varia Fabr.*) should only be regarded as another predisposing cause of the widely occurring trouble known as root disease. No mention has been made of the recent work of Hardy and Turner which indicates a close correlation between the incidence of Froghopper Blight and the acidity of the soil and with which is connected the lime status of the soil.

The second part of the work is devoted to a description of the methods of cultivating sugar-cane in various parts of the world, and forms instructive reading. The book is a valuable addition to current sugar literature.

At the time of going to press the news of the death of the author has been received. His demise will prove a loss to the sugar world.

G. E.

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THE FUNDAMENTALS OF CHEMICAL THERMODYNAMICS. Part I. Elementary Theory and Applications. J. A. V. Butler, D.SC. *Macmillan & Co., Ltd.*, London, 1928. Price 6*s*. Pages 207.

Dr. Butler is to be congratulated on presenting the fundamentals of a complex subject in simple language which can be readily appreciated by the intermediate student. In addition, the book is of considerable value as an introduction to the more advanced and larger text-books on the subject.

R. H. H.

THE CHEMICAL ELEMENTS AND THEIR COMPOUNDS. J. A. V. Butler, D.SC., *Macmillan & Co., Ltd.*, London, 1927. Price 6*s*. Pages 205.

This small book gives, in brilliant style, a general account of physico-chemical bases of modern chemical theory. The author deals with subjects such as atomic constitution, radio-activity, crystal structure, &c., in language which is not only clear and easily comprehended, but which is also intensely interesting. Written by a comparatively young man, the book retains a freshness of point of view which is characteristic. It is valuable as a book to be used in conjunction with larger text-books, and also as an introduction to the study of original papers.

R. H. H.

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FERTILIZERS AND SOIL IMPROVERS. W. Gardner. *Crosby, Lockwood & Sons*, London. 1927. Price 7*s*. 6*d*. Pages 184.

This is one of the best brief accounts of the chief fertilizers of commerce and their applicability as plant nutrients that we remember ever having read. The first Chapter gives a concise yet accurate account of the soil and of soil-conditions controlling plant growth. In Chapter II, the term fertilizer is defined, and the chief sources of fertilizers are named. Some data are also presented showing the world's production and consumption of fertilizers; they include values for the year 1926, but these have since been surpassed, so that the significance of Gardner's figures has already been lessened.

The chief nitrogenous, phosphatic and potassic fertilizers are discussed in the next three chapters. Following this, an account is given in three chapters of various complex fertilizers containing two or all of the three chief components. Among these are described bones, cotton cake, tankage, Diammonophos, Leunaphos, Leunaphoska, Nitrophoska (the last four made in Germany), seaweed, farmyard manure, synthetic farmyard manure, green manure, guano and organic refuses of various sorts. In Chapter IX, compounded fertilizers are considered, and the rules for mixing different fertilizer materials are stated. In this chapter also, special and various miscellaneous fertilizers are described; for example, Phosphazote (from urea and a soluble calcium phosphate); Superam (superphosphate treated with ammonia gas); Zeonite, containing manganese; and sulphur, for adjusting the reaction of soil.

Lime and liming, rotation of crops, and the application of fertilizers to particular crops (of temperate countries), are dealt with in the next two chapters, and fertilizer valuation is explained in the last. Useful tables giving the percentage composition of many fertilizers form part of this chapter. The only disappointment felt by the reviewer was that the term "plant-food" should be preferred by the writer throughout the book to the better term "plant-nutrient."

F. H.

COLLEGE NEWS.

Dr. and Mrs. Hurst and Mr. C. A. de Silva sailed for England by s.s. *Orinoco* on 23rd June.

* * *

Mr. T. R. Hayes and Mrs. Hayes and Mr. E. N. de Lestang sailed for England by s.s. *Pellerin de Latouche* on 21st June.

* * *

Messrs. R. D. M. Barnard, R. W. Stuckey and A. S. Thomas sailed for England *via* Jamaica by s.s. *Carare* on 29th June.

* * *

Our thanks are due to the Cane Farming Department of the Usine Ste. Madeleine for their gift of two levelling shovels.

* * *

We are pleased to announce that Mr. J. A. MacDonald, D.I.C.T.A., has been temporarily appointed Local Chief Inspector under the Plant Protection Ordinance.

* * *

Amongst recent visitors to the College were Messrs. A. Hollmenek and J. Forbes and Professor John A. Todd, the well-known world's cotton statistician, and the Principal of the City School of Commerce, Liverpool.

* * *

We offer our congratulations to Mr. L. S. Birkett, D.I.C.T.A., Post graduate in Sugar Technology, on his appointment as Sugar Technologist at the "Reform Sugar Factory," Trinidad, and to Mr. A. C. G. Palmer, D.I.C.T.A. (Hons.), also Post graduate in Sugar Technology, on his appointment as Sugar Technologist to the "Roseau" and "Cul de Sac" Sugar Factories, St. Lucia.

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The following students accompanied by Professor F. Hardy sailed for England by s.s. *Camito* on 28th June:

Messrs. C. G. Ackhurst, W. Cook, C. W. L. Fishlock, R. H. Fraser, E. W. Gaddum, A. V. Gibberd, W. B. Hutchinson, B. J. Hartley, R. L. Knight, C. W. Lynn, R. D. Linton, R. Leach, A. C. Maher, A. Pickles, A. N. Prentice, J. Robertson, F. R. Sanders, A. E. Trotman, R. Turner, C. A. Thorold, J. Wright, R. G. H. Wilshaw, J. West, J. M. Ward, and Captain J. McN. Wingate. Dr. E. A. Seagar sailed for Barbados by the same opportunity and Miss Edna Kerr for England on three months' leave.

* * *

Dr. and Mrs. J. G. Myers returned to Trinidad by s.s. *Lady Nelson* on 18th June. They spent most of their three months stay on the South American mainland in British Guiana where pests of sugar-cane were studied on the coastlands of Demerara and Berbice. Later a search was made for these and other insects in the more primitive environment of the forest country in the North West District with a view to finding natural enemies which might be utilised in the cultivated areas of this and other colonies. A visit was also paid to Surinam where insect pests of cocoa and other crops were studied. In both British and Dutch Guiana Dr. Myers received great assistance and hospitality from the officers of the Government and from the planting community.

Dr. and Mrs. Myers left Trinidad by s.s. *Chenab* on 8th July for Cuba where considerable time will be spent in making a special study of parasites of the froghopper and of other sugar-cane insects. A visit will later be paid to Haiti and Jamaica.

Dr. R. H. HURST, Ph.D., B.Sc., A.I.C.

An Appreciation.

DR. HURST joined the Staff of the College in November, 1926, as Research Chemist and Lecturer in the Department of Sugar Technology. Previously he had been Research Assistant to Dr. Ramsden, Professor of Biochemistry at the University of Liverpool. Dr. Hurst immediately applied himself to problems connected with the sugar industry. His first publication described his work on the determination of sulphur-dioxide in commercial sugars (*Trop. Agric.* IV, 1927, p. 66). Later, his particular interest in physical chemistry showed itself in his study of the application of some physico-chemical methods to the factory control of sugar manufacture (*Trop. Agric.* IV, 1927, Sugar Supplement, p. 32), namely, determinations of surface tension and of electrical conductivity of sugar-cane juices, syrups and molasses. More recently, Dr. Hurst has completed a series of successful tests on the super-centrifuge as a means of clarifying sugar-syrups and molasses (*Trop. Agric.* VI, 1929, p. 112). This has been followed by an investigation with Professor Scott into the manufacture of edible cane-syrups by the use of invertase applied to cane-juice and other sucrose solutions. The details of this work were published in the form of a Memoir with the July issue of the Journal. In addition, Dr. Hurst has paid particular attention to the experimental manufacture of white sugar direct from cane-juice, and has demonstrated that all the processes tried failed to yield a product equal to refined sugar.

During his tenure of office, Dr. Hurst assisted in the teaching work of his department, dealing mainly with certain theoretical aspects of sugar manufacture. He also supervised the research work of advanced students, both in the College sugar factory and in the laboratory.

Dr. Hurst's quiet unassuming manner won him the respect of his colleagues and students; those of them that were privileged to enjoy his friendship, found him both sympathetic and helpful. The very best wishes of staff and students go with him into whatever sphere of life and work he will grace in the near future.

F. H.

ERRATA.

On page 207 of the July issue, Vol. VI, No. 7, read "*The Planter and Sugar Manufacturer*" for *La Planta* and "Zerban and Sattler" for Zerman and Settler.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

Sugar.—Prices on the Home Markets have ranged as follows (*c.i.f.* per cwt.):

	Foreign.		*Preferential.*	
	s.	d.	s.	d.
9th May	8	10½	12	8¼
7th June	8	0	11	9
17th June	8	0½	11	10½
19th June	8	7½	12	4½
25th June	8	9	12	6
28th June	8	10½	12	7½
2nd July	9	1½	12	10½
9th July ..	9	4½	13	1½
13th July ..	9	6	13	3

According to the *Weekly Statistical Trade Journal* during the earlier part of the week ending 20th June, statististics were received showing that stocks of raws in the United Kingdom as on 1st June were 100,000 tons below last year's figures and with the consumption going on at a good rate English refiners could not remain much longer indifferent to the situation. Also the demand for refined sugar in England increased rapidly which necessitated several advances. This information had an important effect on the London and New York markets and prices have moved upward. The Cuba crop is the largest on record and has yielded 5,156,315 tons.

* * *

Cotton.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association:

	American Mid.	*Egyptian F.G.F. Sakel.*	*Sea Island*		*Prices paid this Week.*
			Good.	*Extra fine.*	
31st May	10·20	17·25	25·50	38·00	25·00-27·00
7th June	10·27	17·00	25·50	38·00	25·50-30·00
14th June	10·33	16·85	25·50	38·00	25·00-30·50
21st June	10·25	15·90	25·50	38·00	23·00-26·75
13th July .... (local)	10·23	—	25·50	38·00	—

There has been rather more demand for Sea Island in Liverpool at fully steady rates. According to the *Commercial* for 20th June, the two main features that have attracted attention were the official consumption report for the American Mills for May, and the report of the boll weevil emergence issued by the United States Department of Agriculture. With regard to the former the returns were eminently satisfactory; the official boll weevil statement, however, showed that emergence is the heaviest in nearly all stations since 1923.

* * *

Cocoa.—The market remains quietly steady despite heavy stocks at practically all terminal ports. There is no pressure to sell by holders. If these conditions continue prices are likely to advance in the near future as visible supplies are light.—(*By courtesy of Cocoa Planters' Association, Trinidad.*)

* * *

Coffee.—Fairly large supplies were offered at auction during June, but the demand has remained poor on the whole, prices for Costa Rica and East African coffees being easier. For the most attractive lots of Blue Mountain Jamaica extreme prices were paid, the PH and CMG marks (bold size) touching 234*s.* 6*d*; second sizes bringing 197*s.* to 210*s.* According to the *Times Trade and Engineering Supplement*, 29th June, the London Market inclines more than ever to good quality coffee and Kenya fairly dominates the market, India being a poor and irregular consigner. The Abyssinian and Arabian growers make no effort to improve their plantations and at 120*s.* to 130*s.* their produce is now under the value of medium to good Kenya.

* * *

Tea.—According to the *Times Trade and Engineering Supplement* for 29th June, the rally in tea prices since a year ago is very satisfactory. All sales for the first half of 1929 are estimated to average 17.82*d.* per lb., against 16.80*d.* per lb. and corrected final figures are not likely to alter the main conclusion that there has been a penny recovery, effected in the main by the improved market for Ceylon and Sumatra tea. Latest weekly averages are 17.55*d.* Ceylon, 15.55*d.* India, 11.80*d.* Java, 15.24*d.* Sumatra. Imports 1st January to 31st May were 184,488,800 lb., Ceylon, and Java being notably good contributors.

* * *

Rubber.—Quotations for Plantation Sheet have ranged as follows:—7th June, 10⅝*d.*, 11th June, 10 9/16*d.*, 13th June 10⅝*d.*, 20th June 10 7/16*d.*, 28th June, 10 11/16*d.* 1st July 10½*d.*, 4th July, 10¾*d.*, 6th July, 11*d.*, 8th July, 11½*d.*, 13th July 11⅛*d.* The market has continued quiet and prices have fluctuated only slightly. The publication of the figures of the Americal monthly *Questionnaire* for May which appeared in the middle of June, had no effect on the Market, the figure for consumption being just about what had been expected.

* * *

Copra.—Prices have undergone a further decline, West India touching £20 12*s.* 6*d.* per ton *c.i.f.* During the last few days covering purchases by bears have imparted a firmer tone to the market as far as near positions are concerned, and the latest business reported has been at £21 2*s.* 6*d.* per ton for June and July shipment. (Gillespie Bros & Co., Ltd. *Monthly Report*, 25th June.)